Pit and Quarry

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WHY HESITATE OVER NEW IDEAS

By A. S. Deringer

THE great majority of American manufacturers and business men like to be considered progressive. They take keen delight in being spoken of as pioneers in some certain phase pertaining to their particular line of business. It is well that this is so, otherwise American industries would not have attained the heights they now possess.

The large up-to-the-minute enterprises did not reach their present high position by one or two leaps and bounds. It required many years of long, strenuous effort to come from one pioneer stage to the other, to attain the present lofty position. Nor are we content to continue at the present pace and present routine with present methods, but are constantly striving to improve existing conditions and our present position to reach still higher and greater achievements. No one now living, unless he be the most stubborn pessimist, will concede to the succeeding generation, the same methods for doing things as they are being done today.

The following generation will see many articles of manufacture produced by different methods than the present. They will see the farmer with more modern farming implements. The manufacturer with more modern methods for producing his products. The housewife will have modern appliances to make the art of housekeeping easier and simpler and less a drudgery. The methods of doing most of the things today are so vastly different from the ways of our grandparents, that we often wonder they were able to carry on and accomplish as much as they did. There are some business men who attempt to carry on in the same manner as their forbears, they are reluctant to provide their business and some even their families with the things that will give their business an up-to-date standing and make life less a burden for their families. They feel that if their grandparents and parents were able to exist and thrive under the old conditions they can do likewise.

The world hates a laggard, it demands of everyone that he be alive to the times, that he be up-to-date in his business and home life, that he provide not only his business but his home with the conveniences that will make life easier and more pleasant and enable him to successfully cope with his up-to-date competitor.

Most of us know of business men who were forced to abandon their business because they were determined to adhere to old-fashioned methods. It has always been difficult for anyone who had a new idea or a new appliance to get the people to accept it with the same faith and confidence that the originator entertained. Everyone was just a little backward in trying out anything new. They were and as a rule are from Missouri. They have to be shown that the idea was tried and true before they would entertain any thought of trying it out.

It is well for the public in general that some of the ideas and notions of would-be inventors and originators did not go over with a bang, because a lot of contraptions that were supposed to do wonders never got beyond the idea stage, and a lot of good honest people who were led to think that certain new inventions were wonderful achievements later discovered they were buncoed.

Another reason for the majority of people to be slow to take up new ideas, is the fact that the average citizen does not live or think in the same sphere as the person who is always looking ahead for new ideas and new methods, who contrives and perfects some new epoch-making appliance, that is just a jump or two ahead of the generation in which we live.

The present generation cannot always conceive the need nor the practicability for some of the new inventions, they are satisfied with their position and their condition, until some progressive individual, who has more foresight and initiative takes up the new idea, and by his success practically forces its adoption upon his competitors.

In this, as in every other phase of life, there are exceptions. Some ideas were taken up and made use of as soon as they became known, primarily because that particular idea filled a long felt want. Too, the simplicity and the possibilities of the new ideas required no long drawn demonstration to make its practicability appreciated and acceptable.

Some lines of present day industries are in dire need of new methods and new ideas, not because present methods are too antiquated or too costly to be profitable, but because they are out of step with the rest of the industrial devlopments, they have not kept pace with the developments and accomplishments that are a generation or two in advance of them. They are still performing in the

same manner, while kindred industries have progressed from one era to a more modern one in the same period.

Some kinds of manufacture do not permit of the rapid advancement that is possible in other lines. Especially is this true in the manufacture of products from raw materials of a mineral nature. It requires certain elements and certain equipment to transform them from the raw state to the various kinds of finished products that are both costly and cumbersome to install. When once installed are generally operated until they reach a stage of absolesence, unless something that is much more economical and simpler to operate is contrived that will produce equal or better results and warrant scrapping the old fashioned and costly equipment.

For some industries there have been contrived new methods that have the appearance of being just the thing the industry required to give it the impetus and progressive aspect it requires to put it on a higher plane of achievement.

Whether these devices will be as practicable and as successful as is claimed for them and as they appear on first analysis, will have to be determined by actual trial and practice. Whether or not these new ideas will prove to be the long hoped for solution or if they will only be the forerunner of a more practicable and more modern and at the same time a more economical idea, time alone can tell.

It is an assured fact that the process of evolution and progression is ever on the forward march. We cannot halt nor hinder its progress, by refusing to accept the new theories and new methods. Some may not be as practicable or acceptable as the period demands, still a future period may hail them as the longed for remedy for the then existing wants. Too, they may be the forerunner of more modern methods that fit even present day requirements.

It is a conceded natural law, that new ideas and new methods will be conceived and perfected as the need for them develops. The perfecting of each new idea will call forth the need for something more modern and so on until the end of time.

PHOSPHATE PRODUCERS HAVE NOTHING TO FEAR

"MILITARY preparedness of European nations is benefitting American farmers who use nitrogenous fertilizers," declared Charles J. Brand, executive secretary and treasurer of the National Fertilizer Association in speaking to Ohio farmers attending Farmers' Week at Ohio State University.

"Governmentally subsidized or quasi-subsidized plants for the manufacture of nitrogen to provide quickly available material for making explosives in the event of war has forced on the world market a large supply of nitrogenous fertilizer. This has contributed materially in bringing nitrogen prices to their present lower level and, since the world production from this and other sources is still increasing, farmers and fertilizer manufacturers may expect lower prices for nitrogen within five years.

"Rapid progress is being made in American production of nitrogen from air without government subsidy. American production from plants already constructed and from those under construction will be surprising."

M. Brand pointed out that already the increased production of nitrogenous fertilizer from synthetic and by-product sources has broken the natural monopoly of Chile, and that Chilean producers are endeavoring to cope with the situation by effecting greater economies and efficiency in production. The Chilean government is giving serious consideration to reducing the export tax of $12.30 per ton on nitrate of soda. In the meantime this country is steadily increasing its producton of sulfate of ammonia, which is derived as a by-product from coke ovens used in the steel industry and from the manufacture of gas for heating and lighting.

"Unless some profound change from post-war policies takes place, American consumers of potash have little to fear from the Franco-German potash syndicate," Brand declared, "because potash prices are practically at the pre-war level. Any undue increase in price would be met by development of domestic sources of potash, including the deposits recently discovered and explored in New Mexico and Texas. In addition, about one-fourth of the present American supply comes from domestic sources which could increase their production if necessary. In time of war the United States could furnish its own potash."

Brand said that phosphate miners in this country have been apprehensive because of a tendency of North African miners, who are subsidized by the French government, to dump phosphate on the American market. If sufficient quantities of phosphate are dumped on the American market, the American miners would be forced out of business.

Other points made by Mr. Brand were that farmers are using more highly concentrated fertilizers, that fertilizer is being used to mature corn more quickly; that it is also being used to hurry the cotton crop to maturity as a defense against the boll weevil, a practice that may be feasible with respect to the corn borer; that the continued low price level of farm products has prevented farmers from properly maintaining the fertility of their soil; that surveys conducted by the United States Department of Agriculture show $3.50 spent for fertilizer on wheat brings a return of $12 to $15 and that the world need not worry about its food supply because that danger has been eliminated by modern agricultural practices.

MEN OF THE INDUSTRY

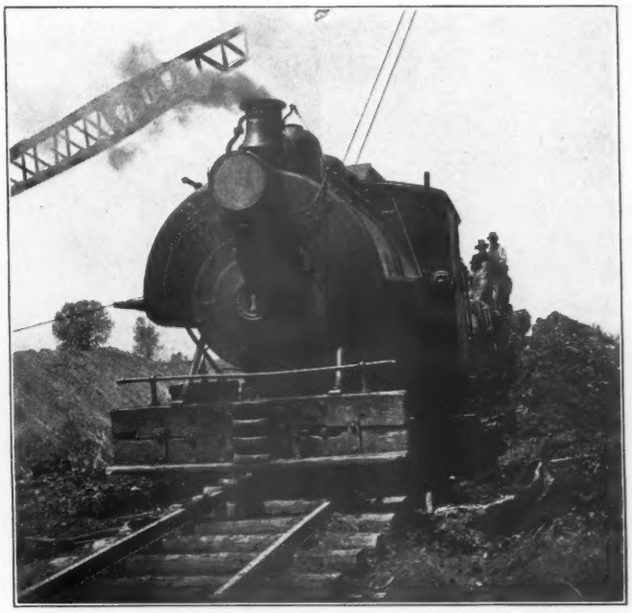
The portraits printed on this page in each number of PIT and QUARRY are taken from our files and their selection is without significance as to current events or as to the position of the individual in the industry.

R. C. Fletcher

Mr. Fletcher is Vice President, General Manager, Sales Manager and Purchasing Agent of the Flint Crushed Gravel Company at Des Moines, Iowa.

WHERE RUHM'S PHOSPHATE IS PREPARED

LOCATED on the Mt. Pleasant Southern Branch of the L. & N. Railroad at junction of East Fork of Bigby and Quality Creeks, about two and one half miles from the little city of Mt. Pleasant, Tennessee, centrally situated with respect to several thousand acres of land containing more than three million tons of the high grade phosphate deposit which has made Mt. Pleasant world famous, stands the magnificent new plant where the Ruhm Phosphate and Chemical Company is now producing their new product, Ruhm's (non-acidulated) phosphate for which is proudly claimed the honor of being the best phosphate on the market and the one that closes in speed of results the gap that has so long existed between the old raw rock phosphate and acid or superphosphate. This phosphate lies in the ground in its natural state as the partially disintegrated remains of several strata of the Bigby phosphatic limestone.



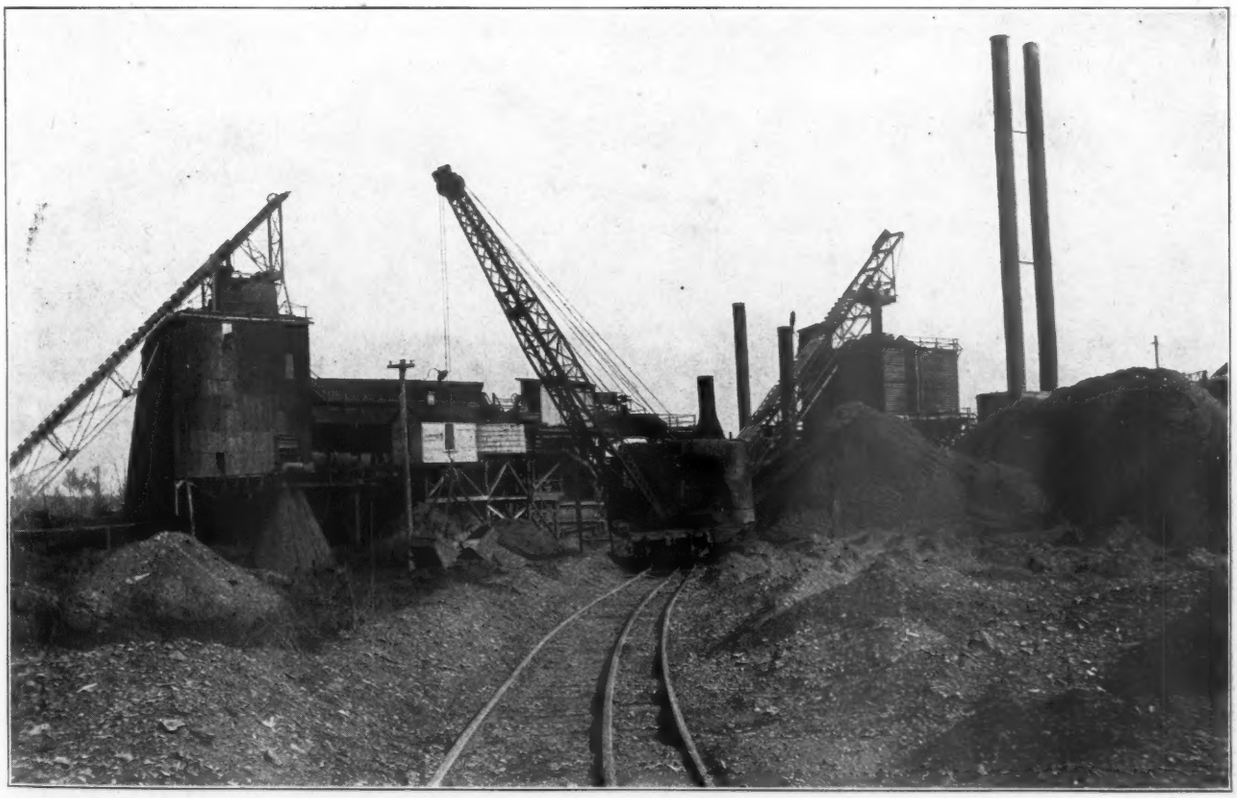
Close-Up of Gasoline Locomotive

Stripping

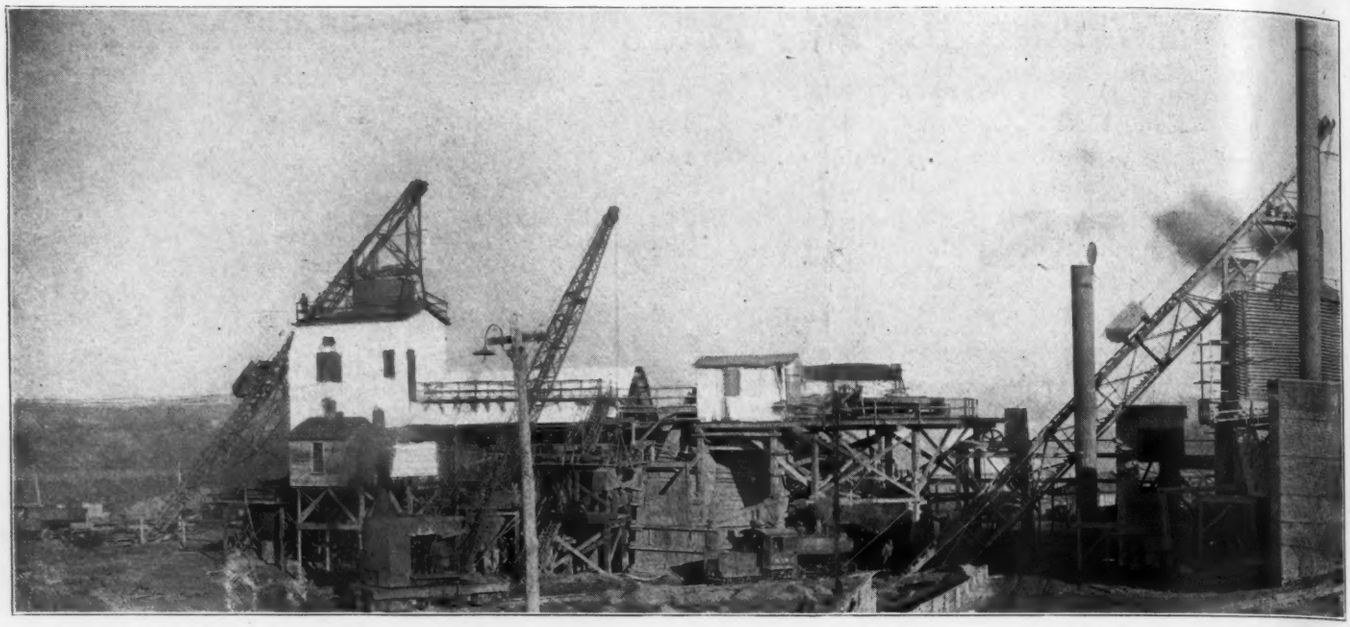
The overburden is the clay and loam resulting from the disintegration of the original subcarboniferous limestones and the Devonian shales and phosphates which once overlaid the Middle Basin of Tennessee and varies from one or two feet to over 18 feet thick. This is removed by long-boom dragline excavators of which there are two of Monighan manufacture, with 70 foot booms.

Mining

After the overburden is removed, the phosphate deposit varying from four to 15 feet thick is mined as a whole with same machines, supplemented by a specially designed cantilever mining machine and by pick, fork and shovel work to clean up in the cutters between the boulders of the phosphatic limestone which form the floor of the mine, all being open cut, back scuttle mining.



Wet Storage Yard with Washing and Drying Plant in Background

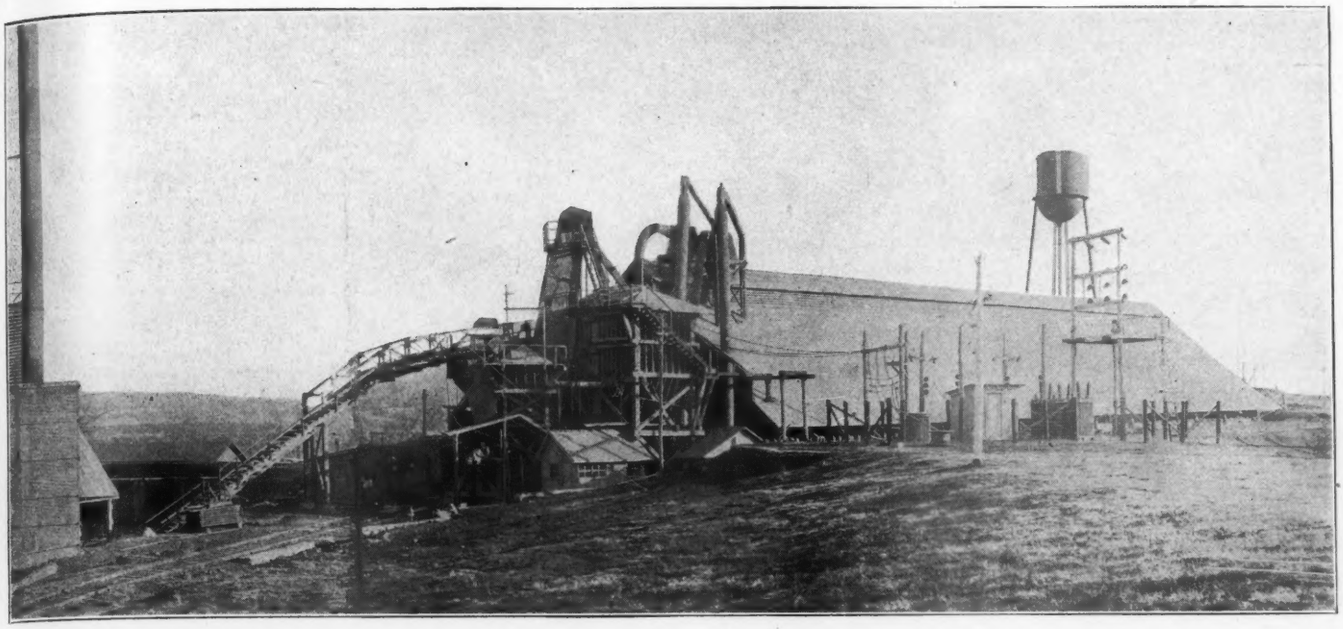


A Panoramic View of the Ruhm

Transporting

The entire deposit is dropped by the dragline and other machines into Western 4-yard dump cars drawn on 3 foot gauge tracks of 65-lb. rail, by 25 ton Davenport mine locomotives, to the dump at the foot of the plant incline. Here it is either dumped alongside of tracks in green storage yard capable of storing over 50,000 tons, or is dumped through tipple into skip hoist No. 1, which takes it up to the top of the washer feed hopper which holds about 16 trams or 1½ hours run.

Loading Phosphate Direct to Cars for Hauling to Plant



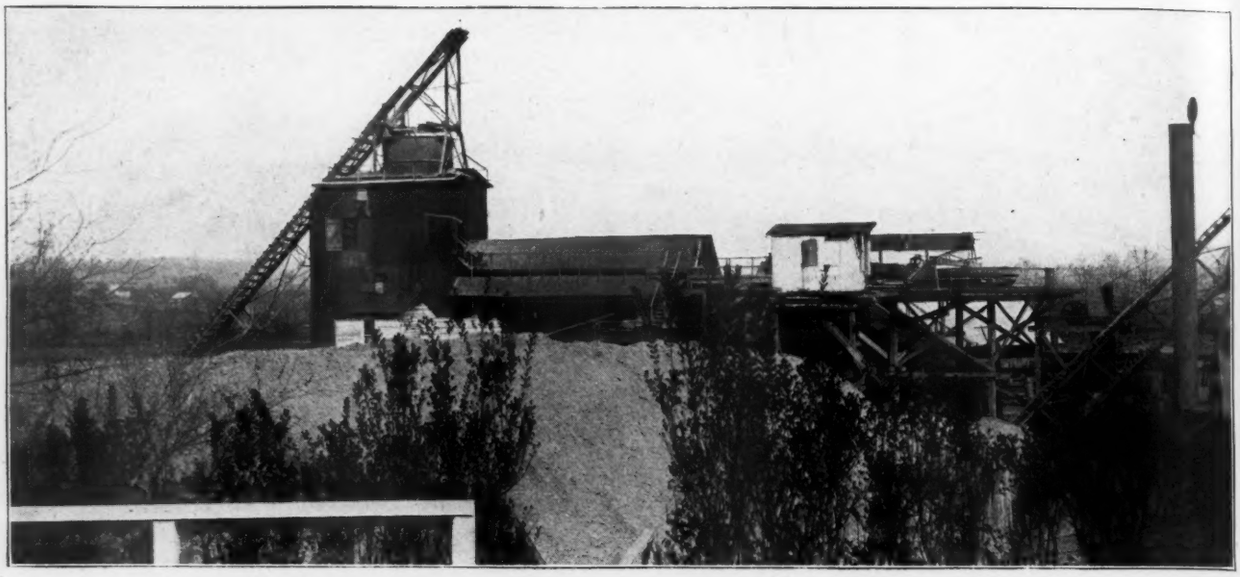
Phosphate and Chemical Plant

Washing

This hopper feeds two sets of specially designed crushing rolls which reduce all pieces to maximum size of 3 inches. The material here contains on dry basis from 58 to 65 per cent B.P.L. with 8 to 15 per cent iron and alumina. Thence the material drops into a specially designed revolving bottom plate mulcher which gives it a preliminary shredding where the clay balls are completely macerated to permit perfect emulsification in the later stages, and feeds it into the preliminary washing cylinder or dasher specially designed. From here it passes to the specially designed main washer cylinder which stands nearly half full of water, the progression of material through the machine being effected by a slight incline and by radial vanes on the inner surface which constantly take the phosphate from the bottom to the top and cascade it back into the water.

The very fine phosphate granules and the clay and other impurities are carried off with the water from the intake end of this cylinder, while the lumps above ¼-inch are centrally discharged to perforated rinsing screens, where the last clay and impurities are rinsed off and the clean lump rock is discharged into foot of Caldwell lump rock bucket elevator which discharges at upper end to 24-inch Goodyear rubber picking belt, alongside of which

Showing the Dragline Removing Overburden at Left and Discharging at Right



Washing and Drying Plant with 10,000 Tons of Storage

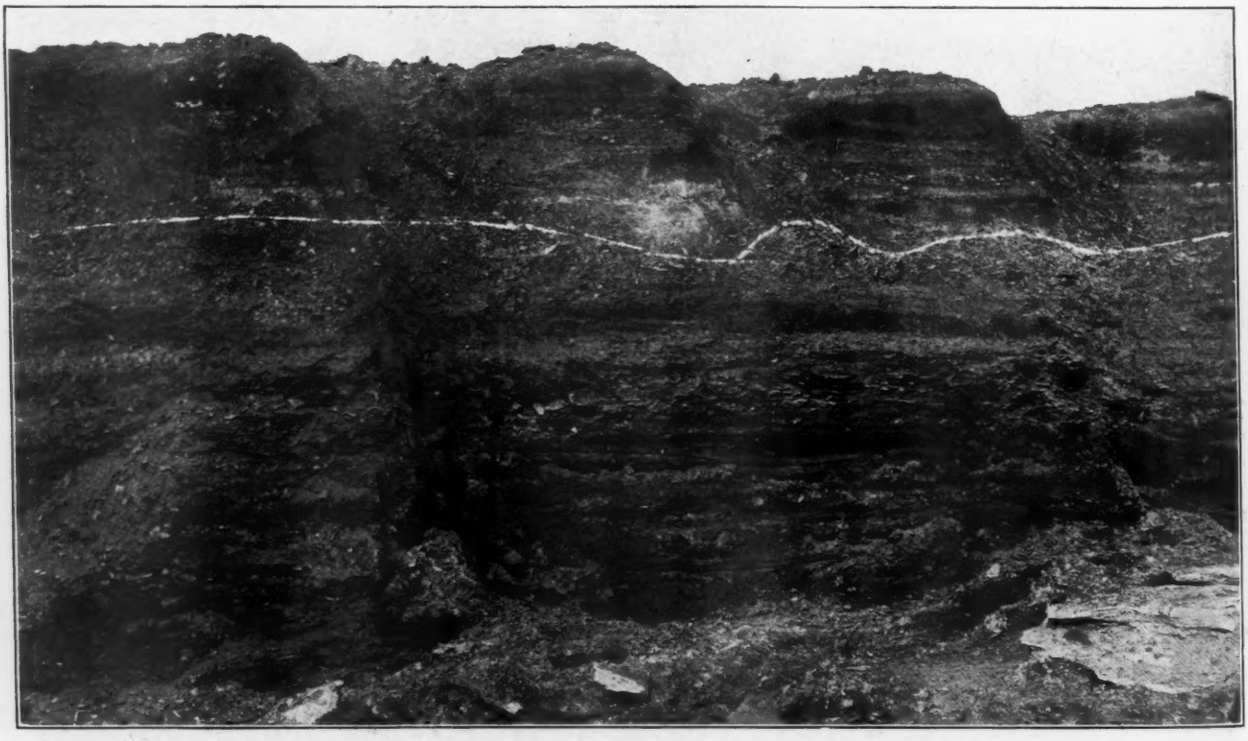
are stationed men and boys who pick out the flint and undisintegrated phosphatic limestone lumps.

If these are picked out entirely, this lump product will show a grade of 77 to 80 per cent B.L.P. with about 4 per cent iron and alumina or better. As these flint and limestone lumps do not increase fluorine, iron, alumina or other objectionable elements, most of the limestone lumps and some of the flint are left in when producing the ordinary grade of 73 to 74 per cent B.L.P.

From this picking belt, the lump material is discharged to the final bin where the washed product accumulates. From each stage of the washing operation above described, the surplus water carries off the clay and other impurities and with them the fine particles of phosphate from ¼-inch down to 100 mesh or finer.

It is a peculiar property of this phosphate, that it will settle to the bottom very quickly, while the clay and loam and other impurities remain longer in suspension and if allowed to completely settle will form a layer on top of the phosphate sand.

This property is taken advantage of by a large number of Allen cones from 6 to 16 feet in diameter which stand inverted with the base upward. The phosphate sand settles to the bottom and issues at the point of the cone, while the material in suspension overflows at the periphery in a steady gentle stream. The first overflow is retreated in another battery of cones to recover still more of



Face of Deposit with White Line Separating Overburden from Phosphate

Dragline Mining Phosphate and Loading Cars

the fine phosphate and the phosphate discharged is jetted to another battery of cones and given a final rinsing separation. All the fines after final discharge from the cones are pumped by 6-inch Morris centrifugal pumps to a Dorr bowl classifier or de-watering machine, which discharges into the same bin previously mentioned, thus remixing the lump and fines, both of which are by this time cleaned thoroughly of clay and other impurities and contain a minimum of deleterious ingredients. The analysis of this combined product shows on a dry basis about 73 to 74 per cent B.P.L. or 14.6 to 14.8 per cent phosphorus.

Waste Fines Recovery

The overflow from all the washer parts goes by gravity to a sump, from which it is pumped by a 10-inch Morris Centrifugal pump through 10-inch steel pipe to an elevated settling box 30 feet above the ground level. Here the last phosphate fines are dropped out in alternate boxes and allowed to accumulate for future handling at times when heavy peak calls on production are made, when they are picked up by locomotive crane and transported in gondola cars back to the dump and fines mixing bin.

Washing Operation

The overflow water from these boxes flows by gravity into 55 acres of settling ponds, where the clay, loam and impurities settle out and the clean water is decanted off at the upper end and returned to the original supply. This washer is supplied from a pond or lake impounding the flow

Dragline at Work Removing Overburden

of both streams, from which it flows 350 feet through one 10-inch and one 8-inch pipe to suctions of two pumps, one a 3 cylinder belt driven Deming pump operating at 55 pounds per square inch and the other a Morris 6-inch centrifugal pump working against about a twenty foot head 800 gallons per minute.

The Power Plant

The power plant alongside the washer plant operates the washer and the drying plant later to be described through a 4-15/16-inch main line shaft 140 feet long, driven by a 36-inch Goodyear main drive belt from an 18 by 36 Allis Chalmers Corliss engine, for which steam is furnished by two 150 h.p. Erie City R. T. Boilers working under natural draft. A jack-shaft 3-15/16-inch and 65 feet long driven from main shaft operates the dryer and storage hoist.

Wet Storage

From the lump and fines mixing bin the washed material is taken by a Variety 25 ton locomotive crane with 70 foot boom and 1½ yard Blaw Knox bucket to huge piles in the wet storage and draining yard, holding over 25,000 tons. Here it drains down from around 25 to 30 per cent moisture to as low as 18 per cent in dry weather.

The same crane takes the material from storage to skip hoist No. 2, which elevates it to any one of four storage feed hoppers holding 80 tons each, located in the top of the dryer structure.

Drying

These bins feed through specially designed feed rolls to either or both of two specially designed cylinder dryers seven feet in diameter 30 feet long, fed at hot end, fired with coal by two Jones underfeed automatic stokers, through brick furnaces lined with Ashland and Harbison and Walker refractory units, covered with Dietrich flat furnace tops.

Dry Storage Crushing

The material is discharged at cold end, through steel hoppers, into 5 ton skip hoist No. 3, which takes it up an incline and along the top of a storage house 80x210 feet with sloping roof supported by Nashville Bridge Co. steel arch trusses resting on concrete pilasters in concrete side walls, the South half of which is used for unground storage, holding 8,000 tons. Underneath this storage house is a concrete tunnel 6 feet wide and 8 feet high in which is a Goodyear 18-inch troughed belt conveyor 240 feet between centers which delivers material to shaking screen made by Schreiner Steel Products Company, undersize from which flows into boot of a Caldwell continuous bucket elevator 60 feet between centers, capacity 50 tons per hour. The oversize +¾-inch passes to boot of Caldwell chain and bucket elevator which discharges into bin hopper over Sturtevant No. 2 gyratory crusher, where it is reduced to ½-inch size and discharges to elevator boot first above mentioned.

Grinding

The entire product thus reduced to maximum ¾-inch is discharged from elevator by chutes to either of two 50 ton storage bins, hopper bottomed to feed two 5 roll High Side Raymond mills with pneumatic automatic feed control devices.

The cyclone collectors of these mills discharge into the top of the north half of storage house above described in which is a concrete floor and at one end of which is the bagging bin. This storage holds 5,000 tons of ground material.

Bagging-loading

A similar concrete tunnel containing a similar conveyor belt runs under this storage and discharges into box car standing on 75 ton Fairbanks railroad track scales, when loading bulk shipments which constitute far the larger part of sales. A

Showing About 7,000 Tons in Storage Ahead of Washing and Drying Plant

loading dock alongside bagging bin permits storage and loading of bagged goods, and plans are made and will soon be executed for automatic conveyors and bagging machines and bag loading conveyors, to take care of increasing bag business.

Final Product

The product thus produced averages 73.7 per cent B.L.P., or 14.7 per cent phosphorus, equivalent to 33.6 per cent phosphoric acid, with only about 2.8 per cent alumina and around 2 per cent fluorine.

A recent average test shows fineness such that 99.63 per cent passes 100, 93.47 per cent a 200, 81.36 per cent 300 and 77.61 per cent a 325 mesh screen and the capacity of the two mills is from 11 to 14 tons per hour. The screen, elevators, crusher and mills are operated by induction Westinghouse motors through Allis Chalmers Tex Rope drives, all handled from central six-panel switchboard. The high tension wires of the Southern Cities Power Company deliver current at 440 volts to transformer station on the property. Alongside the storage house is a Mundy 6x9 double cylinder, double drum engine operating specially designed scrapers which move material from sides of storage to central openings into conveyor tunnel underneath.

Capacities

The washer capacity is 275 tons per day of ten hours. Drying capacity 500 tons and grinding capacity 275 to 300 tons per day of 23 hours. Loading capacity is 45 to 50 tons per hour. Large well equipped blacksmith, carpenter and machine shops, a 50,000 gallon water tank on steel tower, office and commissary, round houses and accessory buildings complete the installation.

The plant is of most modern design and permanent concrete and steel construction and for uniformity of product and complete saving of all phosphate values from the deposit with minimum of deleterious impurities it stands at the head and is a worthy exponent of the position of the Ruhm Phosphate and Chemical Company, as the "oldest and largest producer of finely ground, non-acidulated phosphate for direct application in America." The village of nice substantial homes for operatives and employees consists of 16 houses for white and 35 for colored, with well appointed and conducted schools and churches. The officers and directors of the Company are John Ruhm, Jr., President and Treasurer; H. D. Ruhm and R. P. Hoover, Vice-Presidents; F. K. Hoover and Earl Hoover, Directors; W. S. Mabee, Mgr. of Operations; and S. L. Jones, Secretary. The principal office is at Mt. Pleasant, Tennessee, with offices at 1407 Railway Exchange Building, Chicago, Ill.

Record February Construction

Building and engineering contracts awarded during the month of February in the 37 states east of the Rocky Mountains amounted to $465,331,300, according to F. W. Dodge Corporation. The above figure was the highest February contract total ever recorded for the 37 States. It was 9 per cent ahead of the January 1928 total and was 18 per cent over the record for February of last year. The territory covered by this record included approximately 91 per cent of the total construction volume of the country.

Four districts made new high totals for the month of February, the new records being reached by New York State and Northern New Jersey, Middle Atlantic States, the Central West and Texas. The New England States had a total which was next to the largest February on record.

Last month's contract total for the 37 States included the following items of note: $238,958,100, or 51 per cent of all construction for residential buildings; $59,980,200, or 13 per cent, for public works and utilities; $57,695,400, or 12 per cent, for commercial buildings; $35,413,700, or 8 per cent, for social and recreational projects; and $34,881,300, or 7 per cent, for industrial buildings.

The February contract total brought the amount of work started since the first of this year up to $892,500,000, this being a gain of 15 per cent over the amount started in the first two months of last year. New work contemplated during the past month in these states amounted to $947,003,400. This figure shows an increase of 5 per cent over the amount reported in the preceding month.

Cement and Phosphorus

The Wöhler process for the manufacture of cement and phosphorus consists of the reaction of silica with tricalcium phosphate in the presence of carbon. Portland cement and phosphoric acid ultimately result. By replacing a portion of the silica by alumina, or alumina and clay, to obtain in the slag 2 parts of calcium aluminate to 1 part of calcium silicate, thus forming a fusible cement slag. The resulting gas contains compounds of phosphorus and carbon monoxide. This gas is mixed with water vapor and a halogen acid, and the phosphorus is oxidized to meta phosphoric acid by passing the gas through amorphous carbon; the hydrogen formed mixes with the carbon monoxide to form a water gas mixture.—E. Urbain, France (British Patent 280,763).

Cement and Lime Shaft Kilns

The finely divided material, which may be mixed with coal dust, is charged through tubular openings into the upper part of a shaft kiln, where it meets a counter current of hot gases.—A. Andreas (German Patent 445,014).

WHO BENEFITS FROM BETTER ROADS

By H. O. Smith

Chief, Automotive Division Bureau of Foreign and Domestic Commerce

THERE seems to be a very general erroneous impression regarding the development of better roads and motor car transportation, who benefits, why and how. In the last analysis better roads and motor cars serve as a means to an end—true the builder of roads is supposed to be rewarded with a profit for his risk and labor, but his direct benefits end there—the motor car manufacturer makes an average profit of less than $100 on a car, which, on the average, it has been found gives about seven year's service; this represents a pro rata annual benefit to the manufacturer, over the seven-year period, of only about $14 per year.

Who Benefits Most?

1. The individual who makes use of the road and the motor car transportation.

2. The owner of outlying property, who in effect is brought closer to the market centers of his place of business, or whose children are afforded facilities for going to and from school.

3. The merchant selling groceries, dry goods, and every conceivable article produced and marketed, to meet the needs, tastes and demands of modern civilization. These benefits are constant and continuous.

Such benefits can not be fully realized in most parts of the world without good roads and motor transportation.

How and Why These Benefits?

1. The individual personally benefits through the enhancement of his time in increasing his possible usefulness through reduction in time and effort in getting from place to place, to say nothing of the added pleasure.

2. The selection of a residence is no longer limited to walking distance or street car lines.

The potential earning power of land, otherwise limited through being isolated or inaccessible to the market can be increased to the full productivity of the soil, having become accessible to the markets throughout the year.

3. The influence of market centers is enormously and effectively extended.

Much has been said about the mythical saturation point as applies to the sale of motor vehicles, largely because of misunderstanding or lack of conception of the fundamental facts. The real worry of today is not the possible saturation point in consumption of motor cars, but the possible saturation point in the consumption of the product of the soil and most every kind of manufacturing.

Good roads and motor transportation are the most effective agencies we can depend upon to constantly increase the buying power of the individual in most all civilized countries of the world. There is little occasion for worry about an outlet for what is produced on the farm or by the factory, if satisfactory progress is made in increasing the income from the land of the individual.

The standard of living has been greatly increased, as it applies to practically all strata of society in America, and many other parts of the world, but this has been brought about only as the income of the people has increased. Many parts of the world are only starting on the climb to higher production and high living standards, which invariably reflect the greater purchasing power of the people.

It is interesting to note that this modern development the world over has become evident when and as modern transportation facilities have been developed, and in most every case it is traceable to motor transportation and good roads development.

With the increase in production in most every line there is great need for continued developments of markets and buying power. However, the people of many countries are susceptible of practically as high earnings and buying power and development of a taste for modern things as has been true in America.

The records show, when the people of a country get the broader vision of the benefits of good roads and motor transportation, and realize the big and constant lasting benefits from the same, reflected in the increase in income, buying power and general prosperity, good roads and motor transportation expansion become a definite part of the national program. The development of the use and extensive manufacture of motor vehicles in the United States is not so much the result of prosperity as one of the basic reasons for our prosperity.

Natural Volcanic Cement

A cement freshly prepared from a volcanic ash from Guatemala has considerable mechanical strength but contains considerable combined sulphur. The air and moisture combine on exposure to oxidize the sulphur to sulphates. The formation of these sulphates of calcium and aluminium is accompanied by an increase in volume and, consequently, by a decrease in the strength of the cement. It is not probable that natural volcanic cements will compete with Portland. H. & W. Brintzinger (Zeit. f. Angor. Chem. 168, 93-95).

GRADATION AND CHARACTER OF AGGREGATES AS A FACTOR IN WORKABILITY

By A. T. Goldbeck

Director, Bureau of Engineering, National Crushed Stone Association*

FIRST it is necessary to know what is meant by workability before discussing the character of aggregate as a factor, since concrete is believed to be workable when it may be conveyed with the greatest ease and the least amount of segregation. A workable mix for one mode of transportation from mixer to forms is frequently unsuited with other means of transportation.

In many cases, economy is more important than an easy flowing plastic mass and aggregates up to 6 inches in diameter may be used, but in thin sections, filled with reinforcing steel, the greatest degree of workability is required. The degree is dependent upon the method of transportation; the character of the structure; and the importance of workability in relation to other factors. Some of the characteristics of aggregates which should be considered are the shape of particles; smoothness of surface, or surface characteristics; and mechanical grading.

The mobility of the mass is not alone controlled by the shape of the particles, since the coarse, rounded or angular particles are lubricated by the motar and almost equal mobility may be attained by a suitable change in the proportion to accomplish the purpose. Such a change in proportion does not necessarily mean the use of more cement in one case than the other to produce equal strengths. It is quite possible to obtain equal workability in concrete having angular fragments in comparison with that having rounded fragments by only increasing the sand content and not increasing the cement ratio. This increase in sand requires a higher water ratio in the angular aggregate concrete and yet the strength of this concrete was higher than that containing rounded coarse aggregate. The strength will not necessarily be lower in the angular aggregate concrete because it requires more fine particles and water than rounded aggregate for equal workability. The matter may be summed up by stating that angular fragments for like volumetric concrete proportions produce a harsher working concrete than rounded fragments.

Surface characteristics are of three general classes in reference to coarse aggregates which have two effects from the standpoint of workability: extremely smooth, as water worn gravel and certain types of flint rock; rough as in most crushed stone; and extremely rough and pitted as in blast furnace slag. Roughness produces surface voids in excess of what would exist were the fragments smooth. Roughness of surface probably makes for high internal friction in the concrete mass and decreased workability.

The Structural Materials Laboratory of the Portland Cement Association has undoubtedly done the most extensive work in the study of the effect of gradation on the workability of concrete. The report of Thompson and Fuller in the 1907 Transactions of the American Society of Civil Engineers is one of the most extensive of the older investigations. They state, "That with the same percentage of cement in a given volume of concrete, the densest mixture, irrespective of the relative proportions of the sand and stone was in general, the strongest. The best mixture of cement and aggregate has a mechanical analysis curve resembling a parabola which is a combination of a curve approaching an ellipse for the sand portion and a tangent straight line for the stone portion. The ellipse runs to a diameter of one tenth of the diameter of the maximum size of stone and the stone from this point is uniformly graded."

The fineness modulus is simply a single number which expresses the gradation of an aggregate and it has been found to be a convenient method of calculating the proper proportion of fine to coarse aggregate having given gradations. The limits within which various concretes are workable and beyond which they are harsh working is fully described in the literature of the Portland Cement Association with diagrams showing the range in maximum sizes of aggregate and various average compression strength with concrete of varying degrees of consistency or workability as defined by the standard slump test. From the investigations made the following facts are indicated: the stiffer the mix, the smaller should be aggregates for equal workability; the higher the strength, the coarser may be the aggregate having a given maximum size, because of the use of more cement containing fine particles which lubricate the mass; it is possible to obtain a sufficient degree of workability irrespective of the maximum size and irrespective of the aggregate characteristics by changing the concrete proportions.

It is questionable as to whether or not the best gradation of coarse aggregate for workability can be conclusively determined, but it seems to be the case that the smaller the maximum size of the coarse aggregate, the greater the workability and also the more uniformly graded the coarse aggregate from maximum size to minimum size the more workable the mix. A straight line grading for

*Part of Symposium "Workability."—Abstract of paper presented to the annual convention of the American Concrete Institute, Philadelphia, February 28-March 1, 1928.

coarse aggregates gives good economical workability and may be slightly improved by decreasing the percentage of medium size and increasing the percentage of smaller sizes.

The finer the fine aggregate, or sand, the greater will be the workability, does not mean the use of a fine sand is desirable, for such considerations as strength and economy require as coarse a fine aggregate as will make a workable concrete. If it has too many particles above the number 8 sieve, a sand may produce a harsh working concrete, especially if there is a large percentage of small particles in the coarse aggregate. It is concluded that when like proportions by volume are used, angular, rough aggregate makes a harsher working concrete than round smooth aggregate; a straight line grading for the coarse aggregate extending from the maximum size to 1/10 of the maximum size provides a well graded stone from the standpoint of workability; and the gradation of the fine aggregate should be as coarse as possible for economy but within the limits prescribed for workability.

Critical Condition of Lime Industry to Be Discussed at Convention

The 1928 Convention of the National Lime Association is to be held at the Belmont Hotel in New York City on May 23-24, as announced by the Convention Committee after careful consideration of many hotels and suggested dates. The most emphatic note in the announcement is that this is to be a convention of the industry, rather than of the Association, thus recognizing the sound principle that the industry must be given a time and place to discuss the critical conditions which lost over three million dollars last year, with a decrease of over two hundred thousand tons in production.

To carry out this purpose there is to be no program for the Convention, and no cut-and-dried plan to be offered for acceptance. Members and others are submitting questions bearing directly upon conditions which prevail in various sections of the country, and these questions will serve as the basis of a free-for-all Round Table discussion. It is hoped by all, members and non-members, that this discussion will form some constructive plans to put the industry upon a sound basis.

In order to remove all suggestion of formality and predetermined conclusions, the Chairmanship of the Convention has been given to one chosen for his appreciation of present conditions and his freedom from any part in the controversies which prevail. This is at the request of J. F. Pollock, Chairman of the Board, and expresses the desire of the Board for a strictly open meeting. The Chairman will be S. W. Stauffer, of the J. E. Baker Company, at York, Pennsylvania. Every one present will have an opportunity to talk, as long as his remarks bear upon the real problems of the industry.

The Belmont has been selected from a field of many New York hotels which bid for the Convention, because of its especially fine accommodations for a convention such as this one is to be. It is one of the older houses in the Bowman group, and is well located opposite Grand Central Station on 42nd Street. The rooms are large and very comfortable, and the food is known by travelers and business men to be the best in any hotel in the Metropolis. The management is taking a direct and active interest in the Convention and will give special attention to all reservations.

In order that there shall be no restraint whatever, and that the discussion may be strictly free, barring improper matters, the Convention will not be reported for the publishing of proceedings.

One, probably two, outstanding men will address the Convention, and arrangements are under way with two men whose names will be sufficient urge for every lime manufacturer to attend.

The Convention Committee is headed by S. W. Stauffer, assisted by A. B. Mack, Assistant to the President, Kelley Island Lime and Transport Company, Cleveland, and G. B. Arthur, General Manager of the National Lime Association, Washington, D. C.

Bureau of Mines Undertakes Studies of Nonmetallic Minerals

The work of the Rare Metals and Non-Metals Division in the Economics Branch of the United States Bureau of Mines, Department of Commerce, is to be expanded by increasing its acitivities in the nonmetallic minerals. A special section having to do chiefly with the structural nonmetallics, such as stone, cement, brick and tile, sand and gravel, lime and gypsum, is being organized. Oliver Bowle, formerly Supervising Engineer of the Nonmetallic Minerals Experiment Station, at New Brunswick, New Jersey, has been placed in charge of this section with J. R. Thoenen, mining engineer of the New Brunswick Station, as assistant. The work will be centered in Washington, D. C.

The structural nonmetallics and their primary products have a total annual production value in the United States of approximately one billion dollars, and, through their extensive use in all types of buildings, public works, highways and railroads, their influence touches the life of practically every community and every individual. Intensive study directed toward such business problems as systematized cost keeping, distribution of products, transportation, a better knowledge of markets, market requirements, extension of uses, and similar features that have an important bearing on the healthy prosperity of any industry, would benefit not alone the nonmetallic industries that occupy so important a place in the economic life of the country, but should be of undoubted indirect benefit to the public at large.

QUICK HARDENING CONCRETE

For Use in Construction and Maintenance Work

By F. V. Regal

Engineer of Materials, Missouri State Highway Department*

IN THIS discussion we have endeavored to give, as briefly as possible and within the limits of time assigned, a summary of the general information available in regard to the various methods of obtaining quick hardening concrete. No attempt has been made to furnish detailed data, as to do so in the time permitted would force us to limit ourselves to the discussion of some particular phase of the subject.

We are in the midst of one of the most interesting periods of the development of the use of concrete. New phases of development are confronting us so rapidly that it is almost impossible for a single consumption agency, unaided, to digest and adapt for use all information as quickly as it is made available.

We are in the process of rediscovering some of the fundamental principles of concrete design clothed in new guise; and to complicate the situation, we are offered all of the fifty-seven varieties of wonderworking compounds to be added to concrete for its improvement and for quicker availability.

One of the most interesting of recent developments in the cement and concrete field is that of the production of materials, and of methods which will permit the use of concrete in one or several days following placement, rather than after a wait of from three to four weeks. Concrete has been assumed to be material of slow strength growth until very recently, and expensive delays for aging were assumed to be necessary. More recently, however, our users have been furnished a taste of immediate availability, and the demand has already far exceeded the supply, so to speak.

Rapidly increasing traffic, impatience of the traveling public, considerations of safety, and the practical economy of the situation will no longer permit us to hold our improvements closed, unless well improved detours are available. We are, therefore, confronted with the problem of expanding the service, of which we have finished a taste, to whatever proportions may be necessary to satisfy the legitimate demands of traffic.

For the solution of this problem, we find ourselves at present with two mediums; special cements, and special mixes using normal cements, with or without various accelerating compounds.

Considering first the special cements, we find two general classes, the high alumina cement which produces a quick strength concrete by virtue of its chemical composition, and the so-called super cements which produce quick strength, due to finer preliminary and final grinding, more carefully controlled burning conditions, and possibly to the addition of accelerating agents. The silicates of the high alumina type of cement have been, to a considerable extent, replaced by the quicker hydrating aluminates, and, as we expect, we find practically all of the strength growth of the material confined to a few hours time, with the evolution of a concentrated heat of chemical reaction, which, in standard Portland cement, is evolved during a much longer period. With high alumina cement, we obtain a normal setting period, and an immediate strength growth, such that our requirements are met in twenty-four hours. There is no question as to the production of this strength with proper handling of the material.

From the chemical nature of the product, however, we find, as expected, that most of the ultimate strength is produced immediately. Our strength curves immediately flatten, and in some series of tests show a tendency to fall somewhat during later periods.

In some series of tests, there also seems to develop, at the peak of the curve, a hump indicating a material reduction of strength prior to the flattening of the curve, which reduction, however, does not in our opinion bring the strength down to any alarming degree. This tendency has, however, proven alarming to many, and has been the subject of considerable speculation. In the opinion of the writer, this drop if established as actual and not due to test conditions may eventually be explained chemically, as due to the formation of compounds under the heat conditions existing, which do not persist, but which later stabilize in other forms to produce the strength conditions existing at later ages. We do not, therefore, view these indications with alarm. Tests at later ages are somewhat contradictory, some showing normal tendencies and some showing later drops in strength. The longer age tests are being supplemented from many sources, and the accumulation of data will eventually settle this controversy.

The rapid rate at which the heat of reaction of this material is evolved has beneficial effect at low temperatures and may have the opposite effect under high temperature conditions. From special tests conducted under freezing conditions by the Missouri Department, and previously published, we have found that the heat of reaction furnishes am-

*Presented Before the Mississippi Valley Association January 26, 1928.

ple frost protection, once the reaction was started, and the need of later curing or protection is eliminated.

Under temperatures existing in the summer, the heat developed is sufficient to cause surface blistering or disintegration, if proper curing conditions are not maintained. Surface sprays are recommended, to start as soon as dry spots occur on the surface and to continue until the heat evolution has practically ceased. The surface must be left uncovered to permit dissipation of heat. Cement of this type should not be mixed with normal Portland, and accelerators, such as calcium chloride, should not be used with this material.

The "Super" type of cement is of more recent development than the high alumina type. The strength produced, as suggested before, is largely due to increased fineness, only from approximately one to five per cent being retained on a 200 mesh sieve, and but slightly higher percentages on the 325 mesh sieve. The action of this type of cement, then, is very closely parallel to that of normal Portland cement, and is in effect somewhat the same as would result from richening the mix. For this reason, some of the remarks in regard to the action of normal cement in rich mixes will also have some application to this material.

In some work with air flotation apparatus, which we were privileged to follow some years ago, it was found, in connection with a particular brand of Portland cement, that only 43 per cent of the flour, or material passing the 200 mesh sieve, had any appreciable hydraulic properties, the remainder being inert at early ages, due to coarseness. Simple experiments show that such relatively inert particles become active when ground sufficiently fine. The main strength giving constituent of cement of normal chemical composition, which classification includes the super cement, is assumed to be tricalcium silicate. This constituent may be increased by finer raw or preliminary grinding, coupled with a high line content, the finer grinding together with more careful proportioning and burning resulting in the combination of more of the calcium and silica in the tri-calcium silicate form. These facts plus the possible presence of some accelerator and proper provisions to properly control the setting time of the more active product, gives us, in our opinion, a key to the action of these super cements.

This material differs from the high alumina type in that the rate of evolution of heat is slower. We are therefore free from the disadvantages previously noted when using it at high temperatures, and can cure these products in exactly the same manner as we would normal Portland cement. We have no cold weather advantages, however, and we must protect our concrete during and following placement in cold weather, or lose all time advantages, and consequently our greater investment in higher cost of cement.

The increased fineness of this material introduces a new complication as regards mixing time. As a material becomes finer, below certain limits, greater difficulty is experienced in obtaining thorough wetting and a two minute mixing time is necessary with some of the materials of this type. Wastage of cement as dust in the air becomes appreciable with the use of the finer product and the longer mixing time and must be prevented.

In so far as we know, there is only one high alumina cement on the market, but the number of super cements is multiplying rapidly. We have had an opportunity to work with several products of this nature, and we find a great deal of variation in results obtained. Twenty-four hour strengths vary from that of normal Portland cement at twenty-four hours to greater than that of the same product at twenty-eight days. In the light of our present knowledge or lack of knowledge, care must be exercised to prove the material prior to use and to gauge the opening of work by field control and determination of actual strengths obtained.

Strength results now available, while not so inclusive as might be desired, indicate that entirely satisfactory early strengths can be obtained at summer temperatures with the best brands of this type of cement, and that a continuation of strength growth can be expected, paralleling that of normal Portland cement.

Our observations also have satisfied us that a number of super cements are not sufficiently well developed, as yet, to insure the desired results, and we would strongly recommend thorough investigation of products of this kind prior to acceptance for use. We would stress the fact that normal temperatures are necessary if accelerated strengths are to be obtained. We have in mind a particular bridge reconstruction job involving the raising of pier elevations, and the construction of a concrete floor. The added yardage on the top of the piers was released in twenty-four hours and the bridge lowered into place. As the floor was poured, temperatures fell to freezing, and later remained at 40 to 50° F. It was necessary to hold this portion of the work for eight days before the required strength was obtained.

The fact that this type of material is more normal in action, seemingly has a longer growth period, and at present costs the consumer only about one-half as much as material of the high alumina type, would lead to a prediction that, for general use at normal temperatures, there may eventually be only one type of quick hardening cement. It is only a short step from this point to hazard a guess that, since super cements are so similar to normal Portland cement and can be produced with the same equipment, the improvement of normal Portland cement may be so great that

there will no longer be a need for special cements.

It is interesting in this connection to note that, in territory adjacent to Missouri, during the past three years, the tensile strength of cements has increased from what was in some cases bare compliance with the old specifications of 200 and 300 pounds per square inch at seven and twenty-eight days respectively to a grand average for all companies of 320 pounds and 425 pounds at seven and twenty-eight days, and a high average for a single company of 355 pounds and 462 pounds.

In other words, cement producers are going ahead to solve the problem of earlier strength concrete through quality competition, and have achieved very appreciable and premanent results, while engineers at large are retaining designs and curing periods based on cements previously manufactured.

The manufacture and use of the quick hardening cements are not as yet sufficiently well standardized for any concerted action on specifications. There is also well founded objection, as yet, to making any set of standard specifications for quick hardening cements, which will give the laymen reason to believe that quick hardening cements are of greater ultimate quality than normal Portland cement or which will tend to stabilize conditions and militate against further improvements in normal Portland cement. We are not so certain at this time but that the greatest benefit from quick hardening cements has come to us in the form of improved normal cement.

About the only requirement generally in use in connection with both types of quick strength cements is that the tensile strength at twenty-four hours shall be equal to that required of normal Portland cement at twenty-eight days, or 325 pounds per square inch. The majority of the super cements will very closely approximate the chemical composition of normal Portland cement. Special allowance will be required, however, in connection with the percentage of sulphur present for some brands. The chemical limits also will require rearrangement for high alumina cement on account of its radically different constitution. No soundness requirements have been generally set. Our experience has been that regular soundness requirments will serve if the effects of the heat evolution of the high alumina type are properly interpreted or compensated. Setting times are normal and regular specification requirements can govern.

In meeting the need for concrete more quickly available for use, we have, in addition to special early strength cements, the special richer mixes using normal Portland cement with or without an accelerator.

With such mixes, by proper control of the water-cement ratio, quality of cement and aggregates, time of mixing, and temperature and conditions of curing, we can obtain almost any strength result desired, up to a close approximation of the results obtained with quick hardening cement.

As stated before, the use of a rich mix is closely allied to the use of a finer cement. Any given batch of Portland cement, under a certain set of conditions of mixing, placing, and curing, (temperature and humidity) has a definite rate of hydration. The effect of the use of a richer mixture is not to increase the rate of hydration, but to produce a greater total amount of hydrated material per unit volume of concrete.

All of the factors affecting the strength of ordinary concrete mixtures also affect the strength of the rich mixes, and the richer the mixture, the greater the magnitude of these effects. With these factors in mind, therefore, there is no mystery in regard to the results obtained with rich mixes, and the strength to be obtained can be predicted in the same manner as we do in the case of normal mixes.

A decrease in water-cement ratio, in the range of plasticity, will bring a corresponding increase in strength. An increase in strength of the cement component will increase the concrete strength. Longer mixing periods, particularly with dryer mixes, increase strength.

Since, as stated before, the early strength of rich mixes depends on the hydration of a large number of cement particles, as is the case with super cement, and not on any change in the rate of hydration, and since the rate of hydration is a function of the temperature, it is readily apparent that early strength can not be obtained with rich mixtures, unless the curing temperature is sufficiently high. Temperatures below 60° F. materially decrease the rate of hydration.

One of the main disadvantages of the use of rich mixes, and which may rapidly become a limiting factor along this line of development, is the greater volume change to which the concrete is subject. Both the temperature and moisture coefficients of expansion of concrete increase as the mix is made richer, and more cracking is certain to develop. On a particular series of jobs in mind, we had occasion for reasons of economy to use a very small sized aggregate, and our resulting mix was approximately one of cement to four of total aggregate. The transverse cracking on work of this type using small gravel was twice that experienced with normal mixes using coarser gravel for aggregate. This limitation should also be given consideration in connection with design according to the water-cement ratio theory, some exponents of which would possibly lead us to believe that the only requisites of good concrete are workability and low relative water content. If these are the only factors given consideration, we are very liable, in connection with the use of extremely fine aggregates, to build up such rich mixes that wide variations in temperature will insure a concrete, the main attribute of which will appear to be good crackability.

The main advantage of special mixes, in our opinion, is that the normal Portland cement is readily available and is of a standard quality, lending itself ideally to the flexibility of the special mix. There is manifestly no economy in paying a high premium for a special cement to insure twenty-four hour strength for a considerable length of pavement, which should be opened at an early age when a number of days are required to complete the strength of pavement. In such cases, the last day's work may be designed for twenty-four hour strength, and the remainder of the work graded back in strength with special mixes in such a manner that all of the work can be opened at the same time. Such combinations have been worked in connection with our work with considerable saving as compared with giving maximum acceleration to the total stretch, and we believe that we have a better concrete as a result. It has been our experience that the need for immediate opening of continuous stretches of pavement is exaggerated in many cases and that opening in three or four days would often satisfy existing conditions, practically as well as would twenty-four hour release. It is human nature that a new service will be novel and attractive, and we have found it a problem to restrain the enthusiasm of our field men, who seem to be prone to consider all cases as special and as emergencies requiring immediate action.

We are convinced that we are in general failing to recognize and make use of improvements already available. Questionnaires indicate that many of us are still thinking only in terms of patches and special bottle neck jobs, when our curing periods on all concrete pavement work, for example, could be safely cut in half during summer temperatures. As a result of our studies of the quality of cement available in Missouri, we began over a year ago to check up on a number of representative jobs under varying temperature conditions. Our observations convinced us that our curing period in the summer time could be cut to from eight to fourteen days, and maintain our present factor of safety. The next step, which we are convinced will be universal practice in a very short time, and which will be forced by the economy of the elimination of costly detours in many localities, is the opening of all concrete on the basis of strengths actually developed and shown by field tests. Investigation performed in a number of states along this line shows that with special control, and by testing the concrete at intervals as it ages, slabs from normal mixes can be opened in from three to eight days, depending upon temperature conditions and strength desired. With special mixes, under favorable conditions, this time can be reduced to from one to three days.

The matter thus becomes one of economy. We have high early strength cements at one cost, giving twenty-four hour concrete with attendant advantages and disadvantages. We have special mixes at another cost, also with attendant advantages and disadvantages. Last but not least, we have the opportunity, by intelligent control and field testing, of taking advantage of all the latent possibilities of our regular mixes with or without accelerators. We can pay our money, take our choice, and open our pavements whenever convenience or necessity dictates and our pocket-book permits.

It should be remembered that all methods of obtaining high early strength are as yet experimental, and extreme care should be taken to prove all work with actual field tests, avoiding general or blanket acceptance of particular methods or materials until conclusive information is available, especially as regards later age strengths and durability. The question of future general practice, involving as it does the future production plans of all cement producers, will probably not be answered by some patent formula either of the consumer or the producer, but by the intelligent cooperation of all interested parties.

Importance of Potash

Potash is not only an important ingredient in the manufacture of many products of modern industry, such as chemicals, explosives, medicines, paints, soap, matches, glass, paper, aniline dyes, bleaching agents, and a host of others, but is indispensable in agriculture, state George S. Rice and John A. Davis, in Bulletin 274, recently issued by the United States Bureau of Mines. Justus von Liebig is credited with being the first to discover, about 1858, that potash salts in the soil constitute an essential plant food which is not replaced by nature when exhausted through continued cultivation, that this exhaustion results in a decreasing yield of crops, and that the virgin productivity of the soil may be restored, and indeed even increased, by the addition of suitable potash fertilizers. The fact is now well established that wherever intensive cultivation is employed, whether for the raising of cereals, cotton, tobacco, fruit, or garden truck, the replenishment of the potash content of the soil is essential to the maintenance of production. Hence potash is of primary importance in modern life, not only for the economic welfare of industry, but for the production of valuable raw materials and the very food supply of the nation itself.

Aluminous Cements

Aluminous cements are obtained by heating the raw materials, not necessarily finely ground for at least 30 hours at a temperature above 1150 degrees. Slow cooling for a similar period is recommended. A pre-heating interval is considered beneficial. G. Hertzka, (British Patent 265, 494).

SHORES OF LAKE CHAMPLAIN MEAN BUSINESS TO CROWN POINT SPAR COMPANY

By F. A. Westbrook

THE plant of the Crown Point Spar Company, of Crown Point, New York, has about it several points of unusual interest. It is located on the shore of Lake Champlain on the state highway between Ticonderoga and Plattsburg and close to the main line of the Delaware and Hudson Railroad, from which a short spur has been built to it.

White feldspar is now in good demand and most of the stone being taken out at the present time is of this kind. It is being shipped crude to grinders of feldspar. Here it is prepared for the ceramic industry.

A variety of mica spar products are also obtained for ornamental stucco work, concrete brick blocks and posts and other ornamental concrete work. Poultry grit is also included.

The plant is operated about nine months in the year. Very large storage capacity is available in the bins, as will be seen later, and these are filled by autumn and shipments made from them during winter.

Back of the plant, on the side away from the Lake, the ground rises very rapidly so that it is a simple matter to bring the stone in at the top. The quarry is located about a mile and a quarter away, over the mountain and the stone is transported

Storage Silos and Railroad Siding

Return Conveyor From Rolls

Conveyor From Dryer to Dry Bin

Top of Plant Where Buckets Are Dumped Into Bin Over Crusher

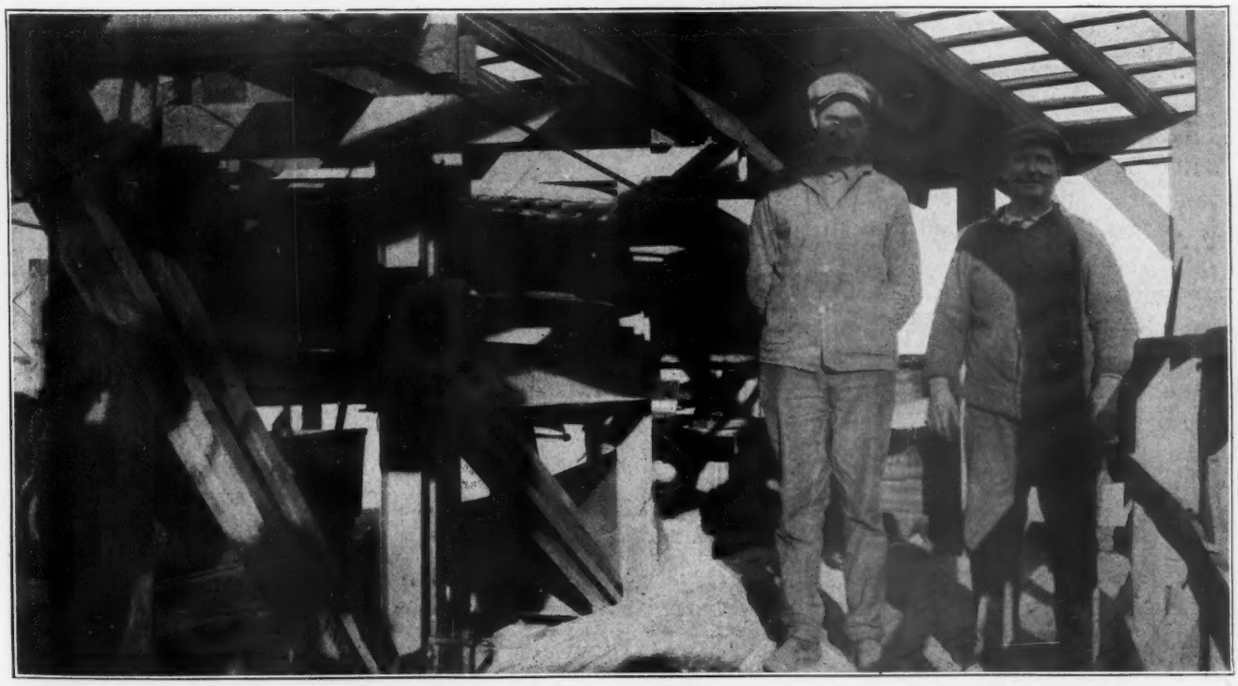
Battery of Vibrating Screens

over an aerial tramway. Thirty to thirty-five buckets, each holding between 500 and 600 pounds, are operated on this line. The supporting towers are made of steel of a design shown in one of the illustrations and they are spaced about 200 feet apart. The supporting cables are of 1¼-inch American Steel and Wire Company wire rope and the pulling cables of ¾-inch wire rope. On account of the up and down grades, with the down grade predominating for the loaded buckets, a 40 h.p. General Electric Company induction motor is sufficient to operate this tramway.

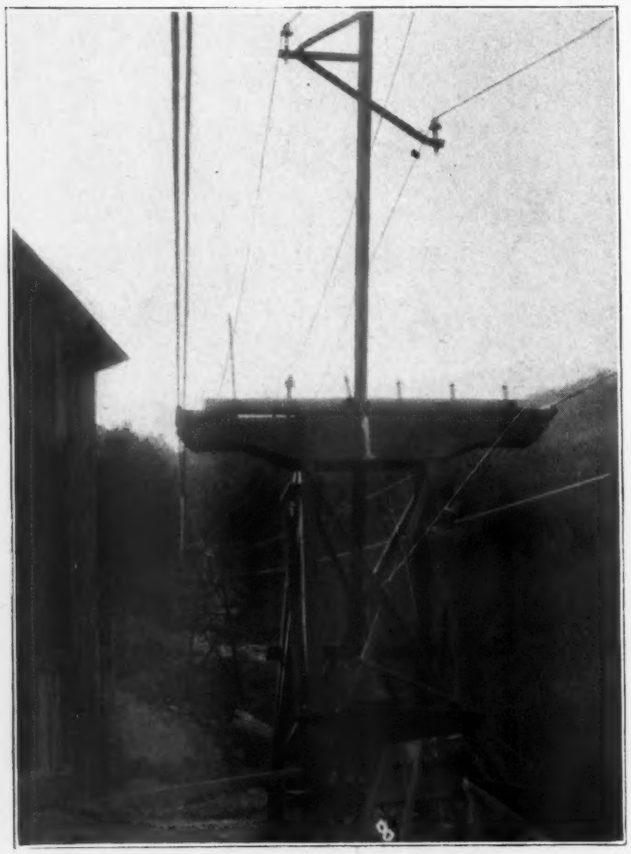
The quarry is rather a large one, having a breast 100 feet high and covering a considerable area. Drilling is done with Ingersoll Rand jack hammers which are supplied with compressed air by a compressor of similar make located in a building on the edge of the quarry. Forty per cent Du Pont dynamite is used for blasting. The rock is picked over by hand and loaded into dump wagons.

The Roller Crusher

At the plant end of the tramway the stone is dumped into a bin over a 10x20 Farrell jaw crusher. Material which is to be ground must of course be dry so it is taken from the crusher on a belt conveyor to a dryer. This conveyor consists of a 14-inch Goodyear style W belt and Stevens Adamson idlers which carries the crushed stone to a vertical dryer and through which it drops zig-



Plant End of the Cableway. Mr. Towne, left, Handles the Buckets at This End. Mr. Thatcher, right, is the Foreman.



Supporting Towers of Aerial Tramway

zag from shelf to shelf. From the bottom of the dryer the stone is carried by another belt conveyor, similar to the first, to the top of the large concrete dryer bin where the dry material is stored.

A 14-inch Stevens Adamson belt conveyor, from under the dryer bin carries stone to the first grinding operation by a Symons disc crusher. From this it is taken in a belt and bucket elevator to the top of the plant to two Newago screens in series in which two sizes of material are produced. The commercial sizes are deposited on belt conveyors extending over the tops of the storage bins, of which more will be said hereafter.

The oversizes from these screens pass through a chute to a series of two Allis Chalmers Superior crushing rolls at the bottom of the plant. The material is then again elevated to the top of the building and passed through two more Newago screens from which the commercial sizes are carried to the storage silos on Stevens Adamson belt conveyors.

As previously stated the storage capacity for finished materials is very large. It consists of fifteen concrete silos arranged in three parallel rows of five each. The silos in the two outer rows hold 400 tons each and those in the middle row 150 tons each. The belt conveyors feeding them from the top are provided with Stevens Adamson trippers whereby the flow is directed into the desired bin. Shipments are made in bulk and in barrels or bags. Loading freight cars is an easy matter with the siding adjacent to the storage bins.

Improved Service on County Roads by Low Cost Methods

By C. N. Connor

Chairman, Low Cost Improved Road Investigation*

According to Thomas McDonald the present statistics show following:

Total mileage of public roads	3,006,081
Per cent of total mileage surfaced	17.4
Mileage of State Highways	274,910
Per cent of State Highways surfaced	52.5

The 1924 figures show that 2,723,195 miles were under the control of counties and townships. This is 91 per cent of the total highway mileage of the country. The surfaced mileage in the county systems is 339,558 or 12.4 per cent, and the unsurfaced mileage is 2,383,637 or 87.6 per cent.

The initial cost of these surfaces must be between $2000 and $10,000 per mile and the surface treatments from $1,000 to $6,000 per mile. The maintenance cost for any of these types should not exceed $1,000 per mile, per year.

From the contents of the paper, and a study of the low cost road situation all over the United States, the following may be definitely stated as facts pertaining to improved road service at low cost.

Such materials as sand-clay, lime rock, crushed or screened gravel, chert, some shales, finely crushed stone and slag are suitable for untreated surfaces.

They can be satisfactorily used as a base for future surface treatments and wearing courses and also as a subgrade treatment for pavement types.

Surfaces which include blading in their construction process result in smooth riding surfaces.

Improved maintenance methods and equipment are requisite for uninterrupted low cost road service.

Maintenance costs on low type roads are higher than for high type, but construction costs are lower.

Sufficient road service can reach the large areas of sparsely populated sections, within a resonable period of time, only by building and maintaining large mileages of low cost roads. For controlled volume and weights of traffic these roads will give adequate service at an average cost per vehicle mile comparable with high type surfaces.

*Abstract of paper presented before the American Road Congress, Cleveland, Ohio, January 11, 1928.

Valuable Material

L. E. Kraus, president of the Kraus Research Laboratories, Inc., New York City, writes of Pit and Quarry as follows: "We find the paper to contain very valuable material."

ANALYSIS OF PORTLAND CEMENT

By Kallauner, Simane and Helan*

IN THE determination of magnesium as ammonium magnesium phosphate, certain investigators hold that the amounts of ammonium salts present are without any influence on the results. (Framm, Neubauer, Gooch-Austin and others.) This is found chiefly to hold good for the ammonium salts of strong inorganic acids; in the presence of the salts of organic acids, and especially of ammonium oxalate, a retarded precipitation of the ammonium magnesium phosphate takes place. (Neubauer.)

For as complete a precipitation as possible of the magnesium, precipitation in the cold (Fresenius, Framm, Neubauer, Bube, Hillebrand and others) as well as with heat (Gibbs, Gooch-Austin, Järvinen, Schmitz, Treadwell and others) are recommended. The cases referred to for the most part concern the estimation of larger amounts of magnesium.

Framm shows that the Gibbs method is not suitable for this precipitation in the estimation of small amounts of magnesium. According to Järvinen there is obtained practically no precipitate by this method in the presence of large amounts of ammonium salts, unless considerable ammonia be added later; then the results are low. On the contrary, Gooch-Austin states that traces of magnesium can be detected even in the presence of considerable amounts of ammonium chloride in a slightly ammoniacal solution and recommends Gibb's method of estimation. According to Hillebrand, it is necessary to drive off the ammonium salts before the precipitation of very small amounts of magnesium.

From what is referred to it is evident that the statements with regard to the estimation of small amounts of magnesium are not in agreement, especially in so far as the ammonium salts are concerned.

In the carrying out of analyses in this institute it was noted that in the employment of the Schmitz method recommended by many analysts, especially by Treadwell, the hot precipitation in the estimation of small amounts of magnesium in current Portland cements in the presence of too large amounts of ammonium salts did not give correct results. Accordingly the problem of the estimation of small amounts of magnesium in the presence of large amounts of ammonium salts such as often occurs, especially in the analyses of Portland cements was taken up in detail and the following results were arrived at:

*Translated from Zement, December, 1927.

Material Used in the Tests

As test material there were employed, partly solutions of magnesium chloride, partly samples of Portland cement. The content of the magnesium chloride solutions was determined by precipitation of the magnesium according to the method of Schmitz as magnesium ammonium phosphate in the solutions A, C and D, using 30 cc. in each case, and in solution B using 100 cc. In addition solution D was checked by a gravimetric determination of the chlorine as silver chloride.

TABLE NO. 1

Solution	Mg P O in cc. according to Schmitz	From AgCl.
	grams	grams
A	0.04405	.....
B	0.000618	.....
C	0.00333	.....
D	0.00320	0.00326

The Portland cement was analyzed according to the method of the German Portland Cement Manufacturers' Association, after the determination of the calcium the ammonium salts were driven off, there being found about 8.5 grams through weighing before and after evaporation. The residue was extracted with dilute hydrochloric acid and the magnesium ammonium phosphate precipitated in a small volume of liquid according to Schmitz and converted into pyrophosphate by ignition and weighed as such. The result of the analysis was the following:

TABLE NO. 2

Loss on Drying	0.75 %
Loss on Ignition	2.52 %
Matter insoluble in HCl	0.75 %
SiO	21.75 %
R O	7.64 %
CaO	63.43 %
MgO	1.70 %
SO	1.38 %

Experiments

I. The following points were investigated:

(1) The influence of varying quantities of ammonium salts.

(2) The influence of dilution of the solution on the quantity of the magnesium pyrophosphate obtained.

(3) The influence of different methods of precipitation; hot precipitation and cold precipitation. Magnesium chloride solutions A, B, C and D were used.

II. The magnesium content in a Portland cement sample was determined according to different existing methods, making use of the information gained in I.

The first point was dealt with as follows: The solution measured from a burette was acidified with 2 cc. of hydrochloric acid 1:1, a certain amount

of ammonium chloride and eventually ammonium oxalate being added and a few drops of phenol phthalein and the whole heated to boiling and neutralized with 10 per cent ammonia with continued stirring. After which, a further addition of 10 per cent ammonia was made, amounting to one-fifth of the volume of the solution. After 24 hours it was filtered through a Gooch crucible and the residue on the filter washed with 2.5 per cent ammonia and then ignited for about one hour at 900 to 950 C. The results are shown in Table 1.

1. TABLE FOR SOLUTION A.

50 cc. of Solution Equals 0.2025 g. $Mg_2P_2O_7$.

Number of Experiment	NH_4Cl in g.	$(NH_4)_2C_2O_4$ in g.	$Mg_2P_2O_7$ found in g.	Difference in g.	Difference in %
1	0,2	—	0,2031	+0,0006	+0,3
2	0,2	—	0,2030	+0,0005	+0,3
3	1,0	—	0,2023	—0,0002	—0,1
4	1,0	—	0,2024	—0,0001	—0,05
5	3,0	—	0,2025	0,0000	+0,0
6	3,0	—	0,2024	—0,0001	—0,05
7	0,2	0,2	0,2023	—0,0002	—0,1
8	0,2	0,2	0,2025	0,0000	+0,0
9	2,0	2,0	0,2024	—0,0001	—0,05
10	2,0	2,0	0,2023	—0,0002	—0,1
11	3,0	3,0	0,2020	—0,0005	—0,2
12	3,0	3,0	0,2022	—0,0003	—0,15

The influence of dilution was investigated as follows: The solutions were diluted before precipitation; they contained 12.5 g. ammonium chloride, 12.5 g. ammonium oxalate, 2 cc. hydrochloric acid and distilled water to a volume of 500 cc. The results are tabulated in tables 3 and 4. The results given in table 2 are for without stirring, while those in table 3 are for with stirring, after 24 hours' filtration was carried out.

2. TABLE FOR SOLUTION B.

50 cc. of Solution Equals 0.0309 g. $Mg_2P_2O_7$.

Number of Experiment	NH_4Cl in g.	$(NH_4)_2C_2O_4$ in g.	$Mg_2P_2O_7$ found in g.	Difference in g.	Difference in %
13	2,5	2,5	0,0296	—0,0013	— 4,3
14	2,5	2,5	0,0307	—0,0002	— 0,7
15	12,5	12,5	0,0262	—0,0037	—12,3
16	12,5	12,5	0,0203	—0,0106	—34,2

3. TABLE FOR SOLUTION C.

50 cc. of Solution Equals 0.1665 g. $Mg_2P_2O_7$.

Number of Experiment	$MgCl_2$ in cc.	$Mg_2P_2O_7$ found in g.	Difference in g.	Difference in %
17	10	0,0261	—0,0071	—24,2
18	30	0,0983	—0,0016	—16,2
19	50	0,1645	—0,0020	— 1,2

4. TABLE FOR SOLUTION D.

50 cc. of Solution Equals 0.1600 g. $Mg_2P_2O_7$.

No. of Experiment	$MgCl_2$ in cc.	Na_2HPO_4 in cc.	Manipulation	Filtered after hours	$Mg_2P_2O_7$ found in g.	Difference in g.	Difference in %
20	10	10	not stirred	24	0,0017	—0,0303	—94,7
21	10	10	" "	72	0,0027	—0,0293	—91,5
22	10	10	" "	144	0,0059	—0,0261	—81,5
23	50	10	" "	24	0,1331	—0,0269	—16,8
24	50	10	stirred; 60 R.P.M.	24	0,1563	—0,0037	— 2,3
25	10	30	not stirred	24	0,0019	—0,0301	—94,0
26	10	4	" "	24	0,0008	—0,0312	—97,7

Concerning hot and cold precipitation, the following was determined: Manipulation similar to that in experiments Nos. 15 and 16; in experiment No. 27 the solution was allowed to stand in a warm place for 12 hours after precipitation and then for 12 hours in the cold. In experiment No. 28 the vessel holding the solution was placed in a refrigerator for 12 hours after the precipitation and then allowed to stand for 12 hours at ordinary temperature.

Number of Experiment	$Mg_2P_2O_7$ found in g.	Difference in g.	Difference in %
27	0.0006	—0.0303	—98.0
28	0.0247	—0.0062	—20.0

With reference to the course of analysis of silicates not decomposed by acids, in which case fusion with sodium or carbonate is carried out; followed with acidification with hylrochlorie acid and resultant formation of sodium chloride. Two additional experiments were carried out with the object of determining magnesium in the presence of large amounts of sodium chloride in addition to ammonium salts. The solution was diluted to 500 cc. and precipitated hot without stirring and filtered after 24 hours.

The precipitate which formed from the filtrate of experiment No. 30 after standing for 24 hours more was collected, ignited and weighed. The amount was 0.0200 g. The total of $Mg_2P_2O_7$ obtained in this analysis was 0.0263 g., a difference of 0.0057 g. less.

5. TABLE FOR SOLUTION D.

Number of Experiment	$MgCl_2$ cc.	NH_4Cl in g.	$(NH_4)_2C_2O_4$ in g.	NaCl in g.	Na_2HPO_4 in2cc.	$Mg_2P_2O_7$ found in g.	$Mg_2P_2O_7$ difference in g.	$Mg_2P_2O_7$ difference in %
29	10	10	10	5	10	0.0067	0.0313	—97.8
30	10	5	5	10	10	0.0063	0.0257	—80.3

In addition to these experiments with magnesia precipitation hot, three experiments with magnesia precipitation in the cold were carried out. These latter experiments were carried out according to the method for the analysis of Portland cement with different amounts of magnesium and ammonium salts. The attempt was made here to fix definitely the influence of large amounts of ammonium salts on the precipitation of the magnesium ammonium phosphate.

II. Experiments with Portland cement.

Experiments Nos. 34 and 35. The Portland cement was carefully analyzed, and the magnesium estimated according to the method of the German Portland Cement Manufacturers' Society.

Found: (a) 1.72, (b) 1.70 per cent of magnesium oxide.

Experiment No. 36: The cement was analyzed and in case 1, but before the precipitation 50 cc. of magnesium chloride solution of a known magnesium content were added and the magnesium estimated as in 1. The amount of magnesium originating from the added magnesium chloride solution was then deducted. Amount found: 1.77 per cent.

The following facts have been ascertained as the result of the experiments:

(a) In the hot precipitation of a magnesium chloride solution according to the procedure of Schmitz and separation of the magnesium as magnesium ammonium phosphate the following were the chief points observed:

1. The precipitation of the magnesium does not seem to be prevented to any extent of any importance in practical work in the case of larger amounts of magnesium salts in small volumes of

solution in the presence of ammonium salts. (Experiments 1-12, 33, 34 and 35.)

2. When the amount of magnesium is very small and the solution greatly diluted the ammonium salts prevent the precipitation of the magnesium to a considerable extent and in some cases they may prevent its precipitation almost entirely when they are present in large amounts. (Experiments 13 to 31.)

3. When the phosphate precipitate obtained is allowed to stand at an elevated temperature, the results are impaired very greatly. (Experiment 27.)

An unusual cooling, however, does not show an especially favorable difference. (Experiment 28.)

4. With a co-equivalent increase in ammonium salts, increasing amounts of magnesium in the solution are precipitated to extents approximating the required amount. (Experiments 20, 23, 31 and 33.)

5. A longer standing has a favorable influence on the precipitation. (Experiments 20-22.) The same results with stirring of the solution, as is evident when the results of Experiments 31 and 33 compared with Experiment 20; further, Experiment 24 compared with Experiment 23; also with an excess of the sodium phosphate. (Experiment 25 in comparison with Experiments 20 and 26.)

6. TABLE FOR SOLUTION D.

Number of Experiment	$MgCl_2$ cc.	NH_4Cl in g.	$(NH_4)_2C_2O_4$ in g.	Manipulation	Filtration after hours	$Mg_2P_2O_7$ found in g.	$Mg_2P_2O_7$ difference in g.	$Mg_2P_2O_7$ difference in %
31	10	12,5	12,5	occasional stirring	24	0,0269	—0,0051	—15,9
32	10	6,0	6,0	" "	24	0,0328	+0,0008	+ 2,5
33	30	12,5	12,5	" "	24	0,0959	—0,0001	— 0,1

6. In the presence of a larger amount of sodium chloride partly replacing the ammonium salts, there is, with decrease in the ammonium salts and increase in the sodium chloride improvement in the precipitation of the phosphate.

(b) Precipitation in the cold of a magnesium chloride solution according to method prescribed for the analysis of Portland Cement Manufacturers' Society resulted in a far superior precipitation, the practical values being correctly obtained in Experiments 32 and 33. In Experiment 31 alone, where the amount of magnesium was small and the amount of ammonium salts great, the result was somewhat lower.

(c) Correct results in the analysis of cement were obtained in practice following the methods of the German Portland Cement Manufacturers' Society. (Experiments 34 and 35.)

The poor precipitation of the magnesium ammonium phosphate in the presence of larger amounts of ammonium salts can be explained according to Bube, that there separates from the solution of the magnesium salt on boiling a monohydrate $MgNH_4PO_4.H_2O$ which is more soluble than the hexa-hydrate $MgNH_4PO_46H_2O$ which separates in the cold.

Solutions of the monohydrate have a considerable tendency to supersaturation on cooling, especially when they are not stirred.

The ammonium ion increases the solubility of the magnesium ammonium phosphate with an increase in concentration, with less concentration it decreases it. As has been established there is on the whole no phosphate precipitate in a solution with a very small amount of magnesium and highly diluted with a considerable excess of ammonium ions when hot.

That supersaturation of the solutions is of most importance is seen chiefly from Experiments 17 to 19 inclusive, 23 to 24 inclusive and 31 and 33.

In Experiments 17 to 19 inclusive and in 31 to 33 inclusive the increased amount of magnesium salts brings about the rapid formation of a considerable amount of crystal seeds as the result of which the supersaturation is diminished and ultimately destroyed; in Experiments 23 to 24 inclusive, supersaturation is again disturbed in the mixing of the solutions.

Final Conclusions

For the precipitation of small amounts of magnesium as magnesium ammonium phosphate in the presence of a larger amount of ammonium salts, neither the method of Schmitz nor any other method involving hot precipitation is suitable. In such a case it is best to carry out the precipitation of the magnesium ammonium phosphate in the cold and by making use of concentrated solutions or by the addition of a known amount of a magnesium salt. Only in the case of unusual amounts of ammonium salts will it be found desirable to drive off these, partially or entirely. The solutions should be stirred, and filtration carried out only after standing for a sufficient length of time, at least 24 hours, or according to our experience, only after 48 hours or more, the latter being preferable.

For the precipitation of magnesium in the analysis of Portland cements the standard method of analysis of the German Portland Cement Manufacturers' Society is suitable for practical purposes. Only in the case of quite small amounts of magnesium, it will be advisable, from our experience, to carry out filtration of the precipitated solution only after standing for 48 hours, at the least, with uniform stirring at frequent intervals during this period, insteda of after 24 hours only.

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Alaska Roads

By M. D. Williams
Acting District Engineer of Alaska*

No road construction in Alaska has progressed beyond a gravel surface type. The saturated condition of the ground makes the use of heavy equipment impossible. A finished grade will support no traffic except on such portions as are on solid rock until a top surface of some type has been applied and subgrades are allowed to settle and drain for one year before surfacing. The cost of beach and glacial gravel on the road is approximately $2.50 and of crushed rock $4.00 per yard.

It is often necessary to use long stretches of corduroy which are placed on the grade, buried to a depth of at least six inches and the surfacing material applied on the grade so prepared, resulting in a floating roadway of sufficient carrying capacity to support 2 to 3 ton trucks. Traffic is in general confined to light cars and small trucks.

Costs are greatly affected by clearing and grubbing operations which vary from $200 to $1500 per acre. Practically all excavation is by hand and contractors work with stationmen using pick and shovel and dump cars.

Excavation costs will average $.80 to $1.00 for common and from $2 to $4 for solid rock.

In the large open plateau country of interior Alaska, clearing is not to be considered as the major item as there is but very little timber, all of which is small and easily removed. During the summer season the ice line is lowered to from 2 to 5 feet below the surface and to a greater depth if tundra is removed and surface loosened. Long stretches of road have been built by removing tundra one season and grading the next by means of tractor and blade. Deep ditches are cut, the material being thrown into a rough turnpike and allowed to drain. Surfacing is then applied. Usually a glacial gravel is used without screening and larger stone removed from the grade. One of the most important problems to be met in the interior is the crossing of the many glacial rivers which carry an immense amount of material, are wide, subject to many floods and constantly changing their channels. Practically all interior roads are built by some form of stage construction which does not look to a completed road for from two to four years.

The Richardson highway has been under construction for many years, first a rough trail, later a passable freight road, and at present a very satisfactory gravel surfaced motor road extending from the coast to the Tanana valley, 400 miles inland. This construction is handled by the Alaska Road Commission under the direction of the War Department which handles road and trail work in the territory, except such as is within the national forests, and expends annually approximately $1,000,000.

The maintenance and construction of all roads during the winter months offers a number of unusual problems. First, the very short period of daylight practically precludes all construction should weather conditions permit, and in the higher and inland portions of the territory glaciating of small streams and heavy snowfall make snow removal and winter maintenance impossible, with the result that travel on such routes is discontinued or reduced to dogs and sleds. On the other hand, coast roads are open at all times, although maintenance is made difficult because of the varying frost conditions in the saturated subsoil.

Coast roads are constructed and maintained by the United States Bureau of Public Roads under the Federal Highway Act. Approximately $500,000 of Federal Forest funds are expended annually by this organization in cooperation with the Territorial Board.

*Abstract of an address before the American Road Congress, Cleveland, Ohio, January 11, 1928.

The Song of a Quarry Superintendent

By W. N. Shaffer

It's hell if I do.
It's hell if I don't.
It's hell if I will,
And hell if I won't.

It's hell at morning.
It's hell in the night.
It's hell when storming,
And hell when it's bright.

Each day that I live,
It's hell pro and con.
It's hell if I give,
And hell if I pawn.

It's hell when I'm flush.
It's hell when I'm broke.
I know sure as hell
It's hell when I croak.

ROCK-DUSTING OF COAL MINES PROGRESSES BUT IS FAR FROM GENERAL PRACTICE

ALTHOUGH it is now generally recognized that widespread explosions can be almost absolutely prevented in coal mines by efficient rock-dusting, and that this rock-dusting can be done thoroughly at low cost, a recent survey by the United States Bureau of Mines, Department of Commerce, shows that, while some progress is being made by the coal-mining industry, many mining communities are slow in taking advantage of one of the most effective safeguards available.

While a similar survey made by the Bureau of Mines in the fall of 1925 showed that about 92 coal companies in the United States were using rock-dust, the more recent survey, made in the summer of 1927, disclosed that the number had increased to 239, representing approximately 160 per cent increase. Similarly, from the fall of 1925 to the summer of 1927, the number of mines using rock-dust increased from 177 to 463, or about 160 per cent increase. This appears to be a decidedly healthy increase, but when it is considered that there are approximately 7,100 bituminous mines operating and that there were only 463 or 6½ per cent, which were even reported to be using rock-dust to any extent whatever, the foregoing figures as to progress leave much room for improvement, the Bureau points out.

A more favorable aspect of the situation is that the annual output of the mines using rock-dust in the summer of 1927 was over 137,000,000 tons, as against about 54,000,000 tons in 1925, hence the mines now using rock-dust produce about 24 per cent of the country's bituminous coal. The fact that mines using rock-dust represent but about 6½ per cent of the total number of operating mines, yet produce about 24 per cent of the tonnage, shows that it is the larger capacity mines which are progressive as to this precaution. Mines using rock-dust in the summer of 1927, employed about 109,000 underground workers out of a total for the United States of about 510,000, hence only about 21 per cent of the underground workers in the bituminous and lignitic mines are being given at least partial protection by rock-dusting. The rock-dusting survey made in the fall of 1925 indicated that mines using rock-dust employed about 50,000, hence an additional 60,000 were brought under protection by rock-dust since that time.

In 1925 it was found by careful inquiry that rock-dust was used in mines in 13 States, while in 1927 this method of mine protection had been extended to 17 States. The States in which most general attention has been given rock-dusting in proportion to the total number of mines operated are, in order: Utah, with 100 per cent of the mines reported as using rock-dusting; New Mexico, with 43 per cent; Wyoming, with 31 per cent; Alabama, with 23 per cent; and Colorado, with 14 per cent.

Pennsylvania, with 129 mines using rock-dust, heads the list of States in number of mines taking this precaution against widespread explosions; West Virginia is second with 89, Alabama third with 52, Utah fourth with 38, and Colorado fifth with 31; then follow Illinois with 25, Wyoming with 19, and Kansas and Kentucky with 18 each.

Although the situation as regards rock-dusting in coal mines has improved much from that in 1923, when scarcely a dozen mines in the United States were using rock-dust, in 1925, when 177 mines used it and in 1927, when the total was 463. Numerous phases of the situation are still by no means encouraging, says the Bureau. Several States have enacted laws or regulations on rock-dusting, but in general they are not effectively enforced. Although the recent survey indicates that rock-dust is being used in 463 mines in the United States, it is decidedly improbable that 50 of these mines are adequately rock-dusted. Bureau of Mines field men have reported a number of mines as being at least fairly well protected from widespread explosions where combined rock-dusting and watering systems are in use, but there have been few if any mines reported as being adequately rock-dusted where dependence is placed on rock-dusting alone. Moreover, there are very few mines in which anything like adequate measures are employed, to ascertain definitely whether rock-dusting which has been done is or ever was of such nature as to prevent or to limit an explosion.

All coal mines, other than high-grade anthracite, should be rock-dusted unless they are decidedly wet throughout, the Bureau of Mines declares. In such mines all open accessible parts (including air courses, abandoned rooms, pillars, crosscuts, etc.) which are not decidedly wet should be kept rock-dusted to such an extent that any dust to be found on ribs, roof, floor, or timbers will have an incombustible content of 65 per cent or over. However, as to working places which are advancing, rock-dusting should be maintained to the last open crosscut in accordance with the above requirements if at all feasible, and the ribs, roof, and floor of the region between the last open crosscut and the face should also be kept wet by the use of hose with water under pressure.

There should be systematic periodical sampling of dust from mine surfaces with prompt determination of incombustible content and with subsequent redusting where analytical work indicates incombustible below 65 per cent. In general, surfaces should be sampled at least monthly, but sampling should be done more frequently where there

is reason to suspect high combustible. Quick simple methods of sampling and analyzing are available, and every mine which uses rock-dust should have this analytical work done as routine procedure. Concise up-to-date instructions for safe, effective rock-dusting are contained in Bureau of Mines Serial 2606, and in Information Circulars 6030 and 6039.

Rock-dusting to be effective must be made an integral part of everyday mining operations; this means that mining companies must rock-dust in essentially the same manner that they timber, blast, ventilate and haul. Where rock-dusting becomes daily routine work its cost will be nominal and seldom should it exceed 1 cent per ton of coal produced. Until rock-dusting becomes a part of routine daily coal-mine operation, it will remain more or less ineffective, and the coal mines will continue to be subject to widespread explosions.

One unfavorable feature is the tendency to assume that the presence of some rock-dust in some parts of a mine gives the entire mine immunity from disaster. This is a decidedly mistaken view, according to the Bureau of Mines. Rock-dusting to be effective must be done thoroughly, and all accessible surfaces of the mine, including haulage entries, air courses, working or abandoned rooms, pillars, etc., should be kept covered with rock-dust unless those surfaces are wet (not damp); and there should be systematic sampling and analyzing of dust from mine surfaces (ribs, roof, floor, timbers) with redusting wherever the incombustible falls below 65 per cent. It should also be borne in mind at all times that rock-dusting, while an effective preventive of widespread explosions involving coal dust, is by no means a cure all for explosions, hence, even if the mine is well rock-dusted, there should be no relaxation in other measures affecting coal-mine safety, including use of effective ventilation, use of permissible closed lights, of permissible explosives, of permissible electrical equipment, etc. In fact, rock-dusting is but one of the many precautions which should be always kept in effective operation if the mines are to be made safe; and rock-dusting must be done thoroughly if its effectiveness is to be assured.

Specifications for Concrete Stone

By C. Van De Bogart

President and Treasurer, Economy Concrete Company*

If we seriously want more unit and group cohesion among manufacturers of concrete stone and a dependable minimum standard of quality and if these discussions accomplish no more than to agree to attempt an agreement, it will be gratifying progress. The demand for standard specifications most assuredly exists and it seems fitting that we should avail ourselves of the existing opportunity to lay a foundation for a specification which will improve our product and promote confidence.

Some manufacturers may view the subject of specifications as a personal matter and feel that conditions properly vary with localities. This is natural but the specification subject is distinctly a group problem and must be solved to meet the requests of architects for specification data from the American Concrete Institute. A poor product anywhere lowers the public esteem for the class of products to which it belongs. For example, A makes good stone while B makes a poor stone. B trades on the good reputation of A and A loses by the bad reputation of B. Hence, the necessity for adhering to some form of a specification.

A specification for concrete stone must be divided into two headings, the characteristics of the stone and the result after setting.

There are those who have rewarded themselves and wrought much damage to concrete stone by finding instances where the composition of concrete stone was of inferior aggregates, no pleasing color and a surface finish comparable to the trowel surface of a side walk. Buildings are trimmed with stone showing a lack of reinforcement, large cracks and super-imposed loads grinding away at the task of breaking down. Careless handling, improper delivery and storage methods; and shipping stone which was cast the day previously exert an injurious effect on the final appearance of the material. These things and setting plans, cooperate on structural details with the builder and architect; facilities for testing, careful planning of deliveries, unless ably handled by the concrete stone manufacturer lessen the value of concrete stone as a desirable material.

The results of setting and general mis-use by mason contractors is the most disappointing feature and the industry must institute an educational program among architects and builders. Pointing and protection of the stone are important items as it is only an inferior piece of concrete that actually leaks water.

Our only expectation of improvement is when we have a perfect combination of architect, builder, manufacturer and owner; combining our knowledge of what to specify, how to manufacture, erect and for what to pay. I submit two things to be done, adopt specifications through the American Concrete Institute and supplement and thoroughly establish the adopted standards; and organize the concrete stone producers into group associations through which to correct the haphazards of our industry.

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*Abstract of paper presented at the Annual Convention of the American Concrete Institute, Philadelphia, February 28-March 1, 1928.

INFLUENCE OF LOW TEMPERATURE AND FROST ON THE STRENGTH OF SUPER CEMENTS

By A. Gessner

ALTHOUGH the super-cements owe their rapid development to a position of outstanding importance in the Portland cement industry to the fact that the formation of a skin on the surface of the cement takes place within as short a time as possible, nevertheless its property of rapid initial hardening also appears to be highly advantageous, particularly in that attempts have been made within the past year to work with these cements at low temperatures. The effect of freezing on the cement must also be taken into consideration. A number of experiments were carried out on this subject, and some of these experiments were principally concerned with the action of frost on the cement and others with the effect of low temperatures, without any freezing action taking place, on the cement during its setting and hardening.

1. The Action of Frost and the Results Obtained

Test samples were made in the form of cubes, seven centimeter side length, from one part by weight of the super-cement and three parts by weight of common building sand. Before setting started, the samples were subjected to the action of frost for a continuous period of five days at a temperature of minus 6 degrees C. or 21 degrees F. The cement mixture did not set within this time, but when subjected for another two days to the same temperature, the cement samples gave a compressive strength of 53.5 kilograms per square centimeter. It, therefore, follows that this treatment does not destroy the entire setting power of the cement. The failure of the cement to set is only a result of the congelation of the water, used in making the cement mixture, to ice. If the freezing of the cement is prevented by the addition of common salt to the water, then the setting of the cement is slowly effected under frost temperatures. The cube test sample made up with the addition of a salt solution containing twelve per cent salt by weight is subjected before setting, which starts after two hours under ordinary conditions, to the action of frost, namely a temperature of 21 degrees F., this action being allowed to proceed for

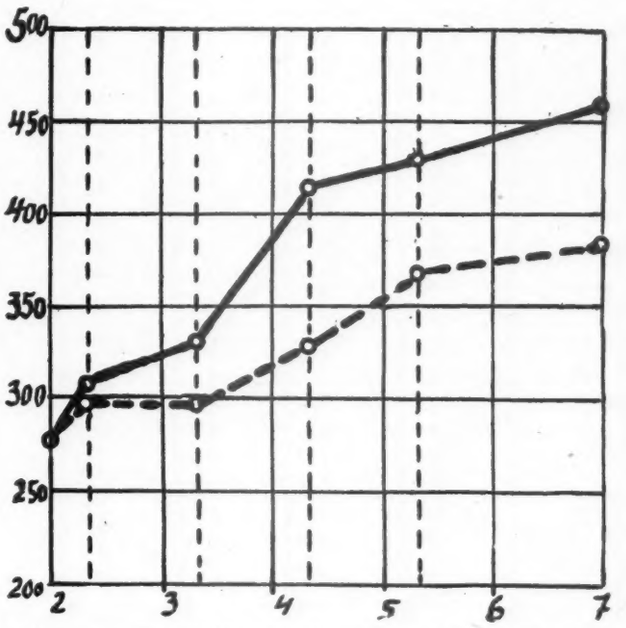

Figure One—The Vertical Numbers Refer to Strength in Compression While the Horizontal Numbers Refer to Days. The Solid Graph Line is for Hardening Without Frost, While Dotted Line is Hardening Interrupted by Frost.

a period of five days. The setting of the cement sample requires eleven hours under these conditions. After five days had elapsed the sample was tested and showed a strength of 34.7 kilograms per square centimeter. It was then allowed to remain in a room at the ordinary temperature for another two days and the final strength of the sample, kept for a total period of seven days, was 197 kilograms per square centimeter.

In spite of these favorable results, the use of common salt and other similar substances, which are added to the cement mixture, should be avoided wherever it is possible. They should, therefore, be used only under exceptionally necessary conditions. Furthermore, in using super-cements care should be taken to see that the concrete or other cement mixture, containing these products, should be allowed to set and to harden within the first twenty-four to forty-eight hours without being subjected to frost. Once the cement has set, then the danger that frost will affect it adversely is materially reduced. It may, however, cause the setting phenomenon to remain stationary at the point where it was when the frost action took place. In other

TABULATION NO. I

Treatment	Strength in compression in kilograms per square centimeter. Age of test sample					
	Two days	2 days 8 hours	3 days 8 hours	4 days 8 hours	5 days 8 hours	Seven days
No frost	278	302	333	416	429	461
Frost on the 3rd day	...	209	...	...	...	429
Frost on the 3rd and 4th day	...	...	297	...	...	422
Frost on the 3rd, 4th and 5th day	...	...	...	330	...	398
Frost on the 3rd, 4th, 5th and 6th day	...	...	...	...	370	384

TABULATION NO. 2

Strength in compression in kilograms per square centimeter (average of four individual tests in each case). Treatment in the first forty-eight hours

Group	Strength after 48 hours	Strength after 7 days Storage 3-7 days Cold water	Warm water
1. Cement mixture placed immediately into the iron mold at a temperature of 32 to 41 degrees F., removed from the mold after 24 hours and then placed in cold water	132	339	470
2. After 24 hours' storage in moist boxes at temperatures of 32 to 41 degrees C. and after an additional twelve hours in the mold the samples were removed from the molds and placed in cold water	185	376	450
3. The samples were kept in the moist box for a period of twenty-four hours and then removed and placed in cold water	195	367	437
4. The samples were allowed to remain in the moist box for a period of twenty-four hours and then were removed and placed in warm water	278	390	461

words, the cement may set up to a certain point but not completely, when the frost effect is felt and this results immediately in further progress of setting being stopped. However, it should be remembered that in those seasons of the year when building operations are generally carried out, the danger is not so much from a prolonged frost but from a sudden frost in the morning or during the night. Two series of experiments were carried out to determine the effect of such natural phenomena.

TABULATION NO. 3

Strength figures according to the German standards in kilograms per centimeter

Two days		Water storage, seven days		Twenty-eight days		Combined storage, 28 days	
Tension	Compression	Tension	Compression	Tension	Compression	Tension	Compression
24.8	31.6	43.4	452	46.0	562	48.5	661

Test samples were first stored in the common manner in wet boxes for a period of twenty-four hours and then for another twenty-four hours in water at a temperature of 16 to 20 degrees C. Then four different samples from the various groups that are indicated in tabulation number I were taken and subjected to temperatures of minus 6 to 8 degrees C. for a period of six hours. In the intervals between the frost tests the samples were allowed to remain in a room at a temperature of 8 degrees C. The samples were all tested within a period of two hours after the frost test, while a second group of samples, which had been subjected to the same frost influence, were not subject to further frost temperatures, but were stored in water at a temperature of 16 to 20 degrees C. for seven days and then tested. Finally individual samples were stored in water at a temperature of 16 to 20 degrees C. without being removed therefrom and without being subjected to the action of frost. The testing of these samples was carried out after the same amount of time had elapsed in the test as in the former cases; that is, those that had been subjected to the action of frost. The influence of the frost temperatures on the retardation of hardening is shown in diagrammatic form in figure 1 and also in tabulation number I.

These investigations first show that super-cements, when they have first been allowed to set completely within a period of forty-eight hours after they have been mixed at the ordinary temperatures, are extraordinarily resistant to the action of frost. The only action of the frost is to retard the hardening of the cement to a certain extent. Hence, after the cement is seven days old, or rather after the mixture is allowed to stand for this length of time under the action of frost temperatures, the strength is less, the more often the hardening process is interrupted by frost. This means,

TABULATION NO. 4

Strength of cubic test samples in kilograms per square centimeter

Age of the sample	Stored in the cold: Temperature deg. F.	Individual values	Average value	Stored at normal temperature 59 to 68 deg. F.: Individual values	Average value	Strength loss in the cold stored sample in per cent of strength of sample stored under normal conditions
2 days	32-36	42 38 40	40	132 134 126	131	69 per cent
5 days	32-36	96 90 90	92	208 208 205	207	56 per cent
7 days	32-39	123 118 120	120	268 268 262	266	55 per cent

for example, that if the sample is subjected to repeated freezing interspersed with intervals within which the hardening process is allowed to proceed, the final strength of the sample will be less, the more frequent the frost intervals. Nevertheless, the strength of the test samples after seven days of hardening, within which there were four days of frost with frost period of six hours each, this strength, amounting to 384 kilograms per square centimeters, is always greater than the strength of normally hardening Portland cement of ordinary grades.

2. Results of Investigations on the Influence of Slight Heating on Setting and Hardening of Cement

Standard cube samples were used in this investigation. Each four samples in each group were subjected to the same treatment. The nature of the storage of the samples during the first forty-eight hours after they had been made is seen from tabulation number 2, which gives the results of the investigation. The four samples, constituting each group, were then tested, that is, forty-eight hours had elapsed. Four samples of the remaining number available were placed in cold water at a temperature of 1 to 3 degrees C. and four samples in warm water at a temperature of 15 to 20 degrees C. and these samples were allowed to remain in the water for a period of seven days.

The effect of low temperatures, just slightly above the freezing point of water during the first forty-eight hours after the samples had been prepared and worked up is accordingly to effect a decrease in the strength. Nevertheless, the influence is not so marked, when the cement is allowed to set during the first twelve hours at normal temperature. The greater reduction of the strength of the sample, which was determined at the end of the second day to be 132 kilograms per square centimeter, is due only to the action of low temperatures during the actual setting time. When the hardening of the samples is permitted to take place at low temperatures, it is found that the phenomenon is retarded as compared to what takes place at a normal temperature of 59 degrees F. On the other hand, the cement has completely recovered the loss in strength which it suffered within the first forty-eight hours due to the action of the low temperatures, after these cement samples had been allowed to remain for a period of seven days, provided the temperature has not been permitted to go down below the normal within that period of time.

Finally an investigation was also made of the reduction of the strength in compression of cement or concrete samples which were subjected to the action of temperatures varying from 32 to 41 degrees F., as compared with storage of the samples at the ordinary temperatures of 59 to 68 degrees F. Large cubes of twenty centimeter edges were used as samples in this test. The mixing proportions were 240 kilograms of cement to one cubic meter of loose mixture, and hence the lowest allowable limit for mixing a good cement was employed.

The strength values obtained with the standard samples of standard Portland cement are given in tabulation number 3. A common form of gravel was used in making the mixture. The concrete was tamped into the regular iron molds and removed from the molds after a period of twenty-four hours had elapsed. The filling of the concrete mixture into the molds and its storage were carried out within a room maintained at a temperature of 59 to 68 degrees F. when the samples are to be subjected to a warm treatment, while the samples which are to be stored in the cold are simultaneously filled into the molds and stored at the low temperatures. These temperatures were measured with the aid of the maximum and minimum thermometer and varied always between 32 and 41 degrees F. The samples were tested for strength in compression after periods of two, five and seven days respectively have elapsed. The results obtained in this series of experiments are given in tabulation number 4.

It is immediately evident from these results that the retardation in the hardening of the samples which were stored at low temperatures is extraordinarily marked. The influence is particularly strongly manifested within the first period of hardening. At an age of five days the cement mixture attains not even half the strength in compression that it has when stored under normal temperatures.

A very clear picture of the results which are contained in tabulation number 4 is shown in diagrammatic form in figure 2. The cement mixture, which is made with the aid of the super-cement always gives strength figures on storage in the cold, which are never less than those that are obtained with ordinary cement in like mixing proportions, the test samples in this case being stored at higher temperatures.

In conclusion it may be stated that super-cements are subject to the action of low temperatures and frost just like other Portland cements, but thanks to their high initial hardening they also attain strength values, which lie above those obtained with ordinary Portland cements. The use of super-cements is therefore highly recommended in working under unfavorable temperature conditions.

Regulating Setting of Cement

The addition of rare earths, such as titanic oxide, together with other material like calcium sulphate regulate the setting time and hardness of hydraulic cements. About 3 per cent of titanic oxide is used. —A Khouvine (French Patent 619,346).

Travel 150,000,000,000 Miles in 1927

How would you like to be assigned the task of driving a motor vehicle around the world sixty-one million times? Driving constantly at an average speed of 30 miles per hour it would take you 571,000 years. But that is exactly what you would be forced to do could you undertake to duplicate the travel of motorists of the United States during 1927.

These interesting figures were compiled by the American Road Builders' Association following the association's report of gasoline consumption during 1927. Motorists consumed 11,563,490,000 gallons of gasoline, which at an average of 13 miles to the gallon would mean a total travelled distance of more than one hundred fifty billion (150,000,000,000) miles.

The average consumption per motor vehicle during 1927 was 550 gallons, and the average distance travelled estimated at 7,150 miles on the ultra-conservative basis of 13 miles to the gallon.

The American Road Builders' Association accredits much of the increased motor travel to the existence of good roads. "These roads," it is claimed, "save from three to four cents for every mile traveled. If all the roads of the United States were improved to a degree proportionate to the amount of traffic they carry, the annual saving in transportation costs would exceed four billion dollars."

Gasoline Consumption Analyzed

Consumption of gasoline by motor vehicles increased 12.4 per cent during 1927, the American Road Builders' Association estimates. The number of gallons of gasoline consumed in the United States totalled 11,563,490,000 gallons, according to figures released by the association.

California led all states in the consumption of the fuel, the vehicles of that state burning 1,017,681,000 gallons. The state of New York ranked second with 892,800,000 gallons. The average national consumption per motor vehicle was approximately 550 gallons. The total number of miles traveled estimated on a basis of 13.5 miles per gallon was placed at more than 150,000,000,000 miles.

All but two states were imposing a tax on gasoline at the close of 1927, the association stated, Illinois and New Jersey having inaugurated a tax during the year. New York and Massachusetts are the only states without the tax. Accurate figures on the amount of gasoline tax were not available, but are expected to run well over $200,000,000 as compared with $187,603,231 in 1926.

The increased consumption of fuel was attributed to the greater popularity of long distance travel, and to the stimulation of vehicle transportation by a larger mileage of good roads. "These good roads," the association explained, "have increased the number of miles per gallon of gasoline, but have given such a stimulus to travel that a larger consumption has taken place." Registration of motor vehicles increased approximately 5 per cent during 1927, the total estimated being 23,125,000 as compared with 22,001,400 in 1926. These figures do not include busses.

The gasoline consumption figures for the states of New York and Massachusetts were estimated. The Illinois and New Jersey figures were estimated on the basis of consumption for the months during which a tax was imposed and figures made available. In most of the states the figures were final and revised, while in Arizona, Arkansas, California, Colorado, Indiana, Iowa, Maryland, Mississippi, New Mexico, Pennsylvania, South Dakota, Utah, Vermont, and West Virginia they are still subject to revision when the final gasoline tax reports are published.

The gasoline consumption in the various states as made public by the American Road Builders' Association for 1927 from figures furnished by the American Petroleum Institute and the various state departments was as follows:

State	Gallons
Alabama	147,225,000
Arizona	41,237,000
Arkansas	99,394,000
California	1,017,681,000
Colorado	129,750,000
Connecticut	159,953,000
Delaware	24,273,000
District of Columbia	57,804,000
Florida	247,951,000
Georgia	192,262,000
Idaho	43,343,000
Illinois	750,960,000
Indiana	347,757,000
Iowa	284,320,000
Kansas	270,615,000
Kentucky	118,273,000
Louisiana	151,605,000
Maine	74,738,000
Maryland	131,798,000
Massachusetts	314,720,000
Michigan	593,372,000
Minnesota	289,686,000
Mississippi	118,371,000
Missouri	322,219,000
Montana	51,046,000
Nebraska	169,677,000
Nevada	12,720,000
New Hampshire	45,722,000
New Jersey	408,300,000
New Mexico	30,654,000
New York	82,800,000
North Carolina	219,583,000
North Dakota	88,583,000
Ohio	770,801,000
Oklahoma	251,462,000
Oregon	130,885,000
Pennsylvania	684,097,000
Rhode Island	61,436,000
South Carolina	101,772,000
South Dakota	87,975,000
Tennessee	148,952,000
Texas	591,447,000
Utah	41,278,000
Vermont	33,532,000
Virginia	166,782,000
Washington	203,421,000
West Virginia	101,396,000
Wisconsin	313,586,000
Wyoming	26,218,000
Total	11,563,490,000

SOME METHODS OF MEASURING WORKABILITY OF CONCRETE

By George A. Smith and George Conahey*

THAT property which is inversely proportional to the effort required to mix and place the concrete in order to obtain a uniform and homogeneous finished product is known as "Workability." "Consistency" and "Workability" as applied to concrete are recognized as representing different properties. Consistency has been defined as a property dependent upon the water used in a particular mix, whereas workability depends not only upon the water content, but also upon the character and proportions of the materials used.

The penetration test is the only means yet developed that has proved satisfactory for evaluating workability. The important defects in the penetration apparatus as designated by Pearson and Hitchcock are, lack of desirable precision; arbitrary units for expressing the workability; and applicability to a limited range of concrete mixes.

An apparatus was developed from a suggestion of Dr. W. H. Herschel of the Bureau for the study of the plastic properties of neat cement pastes. A small ball was pulled through a column of the paste in the brass cylinder by means of weights in the scale pan. By this study it was learned that the addition of fine and coarse aggregates change the nature of a cement paste.

The present method, of using flow table, measures more nearly consistency than workability. Modifications of shape of the table top and in the method of measuring the distribution of the concrete were studied after making the test which might make it possible to measure the workability on the flow table. Segregation of the lubricating medium from the aggregates is one of the causes for the lack of workability in a concrete which was possible to measure by a proper division of the concrete mass after making the flow test. Because of the difficulties encountered, it is believed that the personal element enters into using the flow table for measuring workability, even with the $\frac{1}{16}$ drop to such an extent that it is unsatisfactory as a test. The values for the flat top table with the $\frac{1}{2}$, $\frac{1}{8}$ and $\frac{1}{16}$ drops show the importance of having a uniform and accurate drop at all times, when measuring consistency on the flow table. A small deviation of drop causes a marked change in results.

Dr. L. B. Tuckerman of the Bureau suggested that the resistance of a mass of wet concrete to deformation under a laterally applied load might be an indication of its workability. Three methods of filling the cylinder, four methods of applying the load, four sizes of cylinders and four methods of reducing the friction between the specimen and the base have been tried. The apparatus, as now constructed, consists of a flexible metal mold of number 30 gauge phosphor bronze, 10 inches in diameter and 6 inches high. The bottom edge is fitted with a rubber rim to reduce friction, when the cylinder is deformed and moved across the plate glass base. The upper edge is fitted with two lugs to facilitate the measurement of deformation. The base plate is a section of plate glass 12 inches wide, 14 inches long and $\frac{1}{4}$ inch thick, plated on top of a flow table 12 inches in diameter. The deformation is caused by the application of the load to the lever arms which are 2 by 4 inches in cross section by 5 feet long, pivoted 13½ inches apart on and attached at one end of the table supporting the apparatus. Shot is allowed to run into the load bucket from the reservoir bucket, fitted with a valve in the bottom and suspended on a spring balance. The load is measured by the difference in reading between the weight of the shot in the reservoir bucket at the start and the weight of the remaining shot at the time of reading. In making the deforming cylinder test, the concrete is mixed in the usual manner and placed to a depth of slightly more than 5 inches in a flexible mold and jolted 30 times to settle the load by means of the flow table, with a 1/10 inch drop to settle the height to approximately 5 inches. This enables an accurate estimate of the quantity required to fill the cylinder. Lever arms are placed against the sides of the mold and the load is applied by starting the flow of shot. The difference in workability, as measured by this apparatus, between the 1:2:4 and 1:2½:5 mixes is so small as cause doubt of the value of the apparatus. It is believed that an apparatus using the same principle might be developed for measuring workability.

The improved single rod penetration apparatus consisted of a miniature pile driver to drive a rod into the concrete. The tripping device was set in a fixed position so that the hammer fell through varying distances in driving the rod into the concrete. This variation of height of fall of the hammer made it difficult to calculate the energy expended which was taken as a workability figure. An improvement was made to the apparatus by attaching an automatic tripping device to the hammer so that the height of the drop of the hammer was kept constant. The results of the tests show that the energy so calculated on the modified apparatus measured either workability or a parallel property of the concrete for the results line up in the same order as observed in the field. Different mixes have

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different workability figures, since a 1:1½:3 concrete is easier to place than a 1:2:4 concrete of the same flow and the rich mix has a lower workability figure than the lean mix.

The three rod plunger did not measure as great a difference between the same concrete with a flow of 70, 90 and 110 as was measured by the single rod apparatus. The difference when the rods had penetrated 7 inches was greater but at the depth of 11 inches, the three rod plunger showed very little difference between the three concretes. The space between the cylinder and penetration rod had a marked influence on these results. A cylinder 8½ by 12 inches was built and the program of tests with the 6 by 12 inch mold was duplicated. In these tests, there was a greater difference in the workability figures obtained with the three rod apparatus than with the single rod, indicating that the three rod apparatus is more sensitive than the single rod apparatus.

To compare the results obtained with the improved apparatus with those obtained by Pearson and Hitchcock, tests were made using hydrated lime, Florida kaolin, celite and additional cement to improve the workability. The mix was 1:2:4 and the cement had a fineness of 85.9 and passed all the Bureau of Standards requirements for Portland cement. Fine aggregate was washed river sand, having a fineness modulus of 2.75 and the coarse aggregate was gravel graded from number 4 to 3½ inches. The material was mixed by hand for two minutes from the time the water was added, the flow measured and the penetration mold filled to within ¼ inch of the top and jolted 30 times. The rods were driven down by means of a hammer and the number of blows required for an 11 inch penetration were recorded. The tests compared were made at the same time and consisted of three penetration tests on each of five batches of concrete for each condition.

Pearson and Hitchcock found that the workability of a concrete mixture was about equally improved by the addition of 9 pounds of hydrated lime, 6 pounds of kaolin or 3 pounds of Celite per bag of cement or by the use of 25 pounds of additional cement. The results of the tests showed that, as measured by the three rod penetration apparatus, the workability of a concrete mixture was about equally improved by the addition of these fine materials in proportions used by Pearson and Hitchcock. It is decided that the apparatus developed in the study of the plastic properties of neat cement pastes could not be adapted to measure workability of concrete. We believe that the present penetration process gives the most satisfactory index of workability yet developed and it should be further studied as a standard for evaluating the workability of concrete.

Benefits from Pit and Quarry

J. E. Hewell, of the Florida Gravel Company, Chattahoochee, Florida, writes as follows: "The Hand Book together with your bi-weekly magazine, Pit and Quarry, we find covers very thoroughly the mining industry of non-metallic minerals and also other useful operating data and believe one can greatly benefit therefrom."

Additional Phosphate Discoveries in Montana

When the National Conservation Commission was appointed by President Roosevelt in 1908, it called attention to the fact, among others, that there was an apparent shortage of phosphate rock in the United States. Inasmuch as phosphate rock is the principal source of phosphorus for plant food, any possible shortage was viewed by economists as a distinct menace to our future crop production. The next season the Geological Survey put a number of geologic parties into the field, especially in the Rocky Mountain States, with the result that thousands of acres in Utah, Wyoming and Idaho were found to be underlain by high-grade phosphate rock.

The first discovery of phosphate rock in Montana was made by the Geological Survey in 1910. Since that date successive discoveries have been announced by the Department of the Interior in a series of Geological Survey publications. The latest report in this series, just issued by the Geological Survey, is entitled "Phosphate Rock in the Three Forks—Yellowstone Park Region, Montana." The region described comprises about 7,000 square miles, a considerable part of which is underlain by beds of phosphate rock of workable thickness. In this region, however, the phosphate deposit is thinner and of poorer quality than in other parts of Montana or in southeastern Idaho. The report includes observations on the western phosphate field as a whole and on the occurrence, composition, and origin of the phosphate rock. It also discusses the region by districts and gives measurements of the phosphate beds together with the phosphate content of the samples analyzed.

Hydration of Lime With Steam

The rate of hydration is accelerated by increasing vapor pressure. It tends to fall with rise of temperature provided the vapor pressure remains constant. The chemical activity of lime hydrated at temperatures below 30 degrees is greater when the vapor pressure is lower. Lime which is as active as the best one prepared by natural hydration can be obtained quickly by hydrating with vapor at a temperature of 45 degrees or over. K. Kishimoto (J. Japan Ceram. Assoc.; Kondo C. A.).

PROPOSED BUILDING REGULATIONS FOR REINFORCED CONCRETE*

THE proposed Standard Building Regulations for Reinforced Concrete is something more than just another committee report. This paper is the result of the combined efforts of the committee reporting and the Committee on Engineering Practice of the Concrete Reinforcing Steel Institute. The study of the Tentative Standard Code as adopted by the American Concrete Institute and the code of the Concrete Reinforcing Steel Institute by the combined committees resulted in their agreement on the proposed "Standard Building Regulations for the Use of Reinforced Concrete."

The tests when ordered by the commissioner of buildings, or his assistant, shall be arranged by the owner, or his representative, for which no expense shall be attached to the department of buildings. These tests shall be made by competent persons, qualified by training and experience with the privilege resting with the commissioner to disapprove those whose records show technical incompetency. Records of the results of all tests shall remain in the office of the commissioner for two years after the acceptance of the structure. The commissioner shall have the right to order the tests of any portion of a structure under load, when conditions leave a reasonable doubt as to the adequacy of the structure to serve its purpose. The member or portion of the structure shall be subjected to a superimposed load equal to 1½ times the load plus one-half the dead load, left in position for 24 hours. Tests shall not be required on concrete construction which is less than 60 days old.

An inspection which shall cover the quality and quantity of concrete materials, including water, the mixing and placing of the concrete and placing the reinforced steel, shall be performed by the architect or engineer responsible for the design, or a competent representative of the architect or engineer. Records of inspection shall be available to the commissioner of buildings at all times during the progress of the work and be kept on file for two years after the acceptance of the structure.

Portland cement shall conform to the "Standard Specifications and Tests" of the American Society for Testing materials. Cement and aggregates shall be stored at the work in a manner to prevent deterioration or the intrusion of foreign matter. Deteriorated or damaged material shall be immediately and completely removed from the work.

Natural sands and gravels, crushed rock, crushed air cooled blast furnace slag or other inert materials having clean uncoated grains of strong and durable materials shall be used as aggregates. Aggregates containing soft, friable, thin, flaky, elongated or laminated particles totaling more than 3 per cent or shale of 1½ per cent or silt and crusher dust finer than number 100 in excess of 2 per cent shall not be used. Aggregates shall not contain alkali or organic material which imparts a color darker than standard. Aggregates shall not be larger than one-fifth of the narrowest dimension between the forms of the member for which the concrete is to be used nor larger than three-fourths of the minimum clear spacing between the reinforcing bars. Water shall be clean and free from strong acids, alkalis or organic materials.

Metal reinforcements shall conform to the requirements of the "Standard Specifications for Billet-Steel Concrete Reinforcement Bars of Intermediate Grade" of the American Society for Testing Materials. Wire for reinforcement shall conform to the requirements of the "Tentative Specifications for Cold Drawn Steel Wire for Concrete Reinforcement" of the American Society for Testing Materials.

Plans submitted for approval or used on the work shall clearly show the strength of concrete for which all parts of the structure were designed. Working stresses for the design of structures shall be based upon the minimum ultimate 28-day strength of the concrete to be used in the structure. The strength of concrete shall be fixed in terms of the water cement ratio by established results for average materials as provided or by a specific test of materials for the structure as provided.

Assumed Strength of Concrete Mixtures

Water Cement Ratio U. S. Gallons per 94 pound sack of cement	Approximate Mix Volume Volume of Portland Cement to Sum of Separate Volumes of Fine and Coarse Aggregates as Measured Dry	Assumed Strength at 28 days in pounds per square inch. Compressive Plastic Concrete
8¼	1:7	1,500
7½	1:6	2,000
6¾	1:5¼	2,500
6	1:4½	3,000
	Moderately Wet Concrete	
8¼	1:6½	1,500
7½	1:5½	2,000
6¾	1:4¾	2,500
6¾	1:4¾	2,500
6	1:4	3,000

Where water cement ratios are to be established the tests shall be made in advance of beginning operations, using the proposed materials and consistencies in accordance with the "Standard Method of Making Compression Tests of Concrete" by the American Society for Testing Materials, including the provisions for curing in a moist room at 70 degrees Fahr. A curve shall be established to represent the relation between the average 28-day strength of concrete and water cement ratios. Tests shall include four different water cement ratios and four specimens for each water cement ratio. The rate to be used in the structure shall be that

*Abstract of Paper presented at the Annual Convention of the American Concrete Institute, Philadelphia, February 28-March 1.

corresponding to a point on the curve established by these tests representing a strength of 25 per cent higher than the minimum ultimate strength required by the plans. The commissioner may require a number of additional tests during the progress of the work, but at least one specimen for each 50 cubic yards of concrete of any strength and not less than two specimens of each strength for the operations of one day.

Proportions of aggregates to cement shall be such as to produce a concrete that will readily work into the corners and angles of the form and around the reinforcement without excessive puddling and without permitting the materials to segregate or the free water to collect on the surface. Aggregate shall be of such sizes that when separated by the number 4 standard sieve not less than one-third nor more than two-thirds of the entire weight shall remain on the sieve. The faces and corners of the structure shall show smooth and sound when forms are removed.

All water, debris and ice shall be removed from excavations before concrete is deposited; any flow of water shall be diverted; and water vent pipes and drains shall be filled by grouting after concrete has hardened. All equipment for mixing and transporting shall be cleaned and reinforcement shall be clean of ice or other foreign substances. Concrete shall be mixed until there is a uniform distribution and the mass is uniform in color and homogeneous. It shall be transported from the mixer to the place of final deposit, as rapidly as practicable, by methods which will prevent separation or loss of ingredients and deposited as nearly as possible in its final position to avoid rehandling or flowing. When depositing concrete at freezing or near freezing temperatures, it shall have a temperature of between 50 and 120 degrees Fahr., and shall be maintained at a temperature of at least 50 degrees for not less than 72 hours.

Forms shall be substantial and sufficiently tight to prevent breakage of mortar; and conform to the shape, lines and dimensions of the structure as embodied in the plans. Forms shall be removed in such a manner as to insure the safety of the structure. Metal reinforcement must be formed as indicated on the plans and be free of rust scale or coatings to destroy or reduce the bond. It shall be accurately placed and supported by concrete or metal chains, spacers or hangers and the minimum center to center distance shall be 2½ times the diameter for round bars or 3 times the side dimension for square bars. Bars at the upper face of any member shall be embedded a clear distance of not less than one diameter or less than one inch. Splices in slabs, beams and girders shall not be made at points of maximum stress except with the approval of the commissioner and they shall provide sufficient lap to transfer the stress between bars by bond and shear.

Metal reinforcements shall have a minimum covering of three inches at the under side of the footings and for other surfaces exposed to the weather the metal shall be protected by not less than two inches of concrete. For fire resistance, it shall have not less than one inch of concrete in slabs and walls 1½ inches in beams, girders and columns, provided aggregate shows an expansion no greater than trap rock or limestone. If material of this class is not obtainable, the covering shall be one-half inch thicker and shall be reinforced with metal mesh with openings not exceeding three inches. Exposed reinforcement intended for bonding with future extensions must be protected from corrosion.

The design of reinforced concrete members shall be made with reference to working stresses and safe loads. The accepted theory of flexure as applied to reinforced concrete shall be applied to all members resisting bending, assuming that the steel takes all tensile strength and the ratio of the modulus of elasticity of the steel to that of concrete is the modulus of elasticity of steel in tension divided by the ultimate strength of concrete at the age of 28 days. The provisions as specified, in the report, are based on the assumption that all structures shall be designed for all dead and live loads coming upon them. The live loads to be in accordance with the general requirements of the building code, of which the paper forms a part, with such reduction for girders and lower story columns as are permitted.

Separation of Fine Sand from Sludge

A pipe for delivering clean water is led through the centre of a sludge pipe and opens in a downward direction over the outlet in the bottom of a hopper to prevent accumulation of sand near the outlet and to ensure a steady and uniform discharge. A diffuse in the form of a horizontal shield is fixed to the bottom of the pipe and additional water is supplied by radially disposed pipes immediately above the outlet. The upward flow of water causes the lighter particles to overflow at the top of the hopper. O. N. Rikof (British Patent 278, 468 & B. C. A.).

Cement for Water Line Breaks

A mixture of neat aluminous cement with 20-50% of Portland is made which will begin to set in 2-3 min. and will be completely set in 4-5 minutes. A slight excess is mixed dry and the correct amount of water added. It is mixed very rapidly and kneaded into a ball which is shoved into the hole to be stopped. A layer of aluminous cement mortar should be put on next. In stopping springy ground preparatory to concreting, a 1 : 4 or 1 : 5 mortar of aluminous cement is recommended. It should be mixed quite dry and tamped into place. H. Vierheller (Tonindustrie—Ztg. 51, 1807 and Anderegg, C. A.).

HOW LUMBER AND MATERIAL DEALERS BENEFIT FROM THE STANDARDIZATION OF CEMENT

By F. C. Wenthe

WHEN lumber and material dealers order Portland cement of any brand they expect and are entitled to receive a dependable product of known quality, suitable for use in any kind of construction, promptly delivered and at a fair price.

Dealers have not always had these advantages. They enjoy them today because cement has been standardization through a uniform specification adopted by the United States Bureau of Standards and leading engineering societies. This standard was adopted as a means of decreasing cost and of insuring a dependable, uniform product. For similar reasons, manufacturers of other building products, with the cooperation of the Department of Commerce of which Herbert Hoover is head, are following the example of the cement industry in standardizing their materials.

In the old days great confusion existed in the building field because of the numerous varieties and grades of portland cement on the market. At one time there were gathered between 200 and 300 specifications for cement, no two of which were alike. This situation led to uncertainty and doubt in the construction field, caused great inconvenience and resulted in large losses.

Dealers no longer suffer from these confusing conditions. Standardization has eliminated hundreds of possible varieties or kinds of cement with the uncertainties following such variations. Regardless of what brand of cement dealers buy, they now are sure of a uniform quality which their customers can use with confidence no matter what their jobs are or where they are located.

In addition to dependable quality, dealers also gain through the improvement in the product which has accompanied standardization. George K. Burgess, director of the U. S. Bureau of Standards, says: "It has been shown that adoption of standard specifications would not terminate effective work (improvements) on the specifications. In fact, it seemed to stimulate such activity. . . . . Standardization based on research and service does not make for stagnation but for progress." Adoption of standard specifications for cement is only a step in a continuous process of use and experimentation with a view of raising the standard still higher and of providing a more economical product. Thus the standard specifications have been revised upwards five times since they were adopted, the last time being about a year ago, when tensile strength requirements were increased for both 7-day and 28-day periods. These revisions were decided upon following study and recommendations by a committee of the American Society for Testing Materials, consisting of 72 members, over half of whom are users, not manufacturers of cement. The committee includes prominent representatives from various departments of the U. S. Government and from leading societies of architects, engineers, contractors and other authorities in the construction field.

Dealers profit further from standardization because portland cement, made according to a single standard, is quickly available, under some brand, almost everywhere. With a standardized product and with plants scattered thruout the country all making cement to meet the same standard, it is an easy matter for the dealer to keep some brand always available for his customers' use. If, on the other hand, there were, say, a hundred varieties on the market and a certain variety was specified for a given job, it might be difficult or impossible for the dealer to secure that particular kind when needed. In that case either construction would be delayed or another grade would have to be substituted. Today a dealer can supply any brand for any job knowing that because it measures up to standard specifications, it will give satisfaction.

Because he does not have to stock and handle numerous kinds, the dealer is able to cut down his overhead and capital required to do business. Take a dealer, for example, who handles three brands of standard cement. Suppose manufacturers who now make standard cement began to make, say, four different kinds. Then that dealer would have to carry, not three brands alone, but four kinds of three brands. He would have to stock and handle a dozen different grades and brands. This would necessitate increasing the amount of money invested in his business, would require him to enlarge or change his warehouse to store twelve kinds instead of three brands, would reduce his turnover and would increase labor and handling costs. His expenses would rise without any increase at all in sales or profits unless he increased his prices, in which event the user would have to pay more for cement than he does now. Standardization prevents such an unprofitable condition. The dealer today can meet all construction needs, if he so desires, with but one brand of cement. This keeps down his overhead, reduces amount of his investment, cuts handling costs and simplifies his work.

Standardization, too, results in lower prices. This is because the maximum economy in manufacturing, packing shipping, selling, marketing and use is obtained by a single standard. An automobile company, for instance, that confines its output

of, say, 200,000 machines per year to one kind of car can produce more economically and can offer buyers a lower price than a company that annually makes 200,000 cars of 12 different kinds. The same principle is true of manufacturers of shoes, clothing or building materials. The Hoover Committee found, for example,that producers of asphalt for paving or road work due to non-uniformity in specifications made 102 different grades or varieties and declares, "therefore the economic loss becomes large." The number of grades was subsequently cut about 90 per cent. In the metal lath industry the number of varieties was reduced over 80 per cent. In the case of paving brick, according to the Hoover report, "Efforts of the first conference resulted in an elimination of 55 varieties out of 66 with a great saving to manufacturer, producer and user." In the same way, it is estimated that 250 million dollars was saved by a 60 per cent reduction in lumber sizes. The Hoover Committee estimates that 10,000 million dollars could be saved annually in the United States by "standardization and simplified practice alone." On the other hand, being already a standardized commodity, cement involves no such waste to material dealer, manufacturer and user. Because portland cement is standardized and because all brands measure up to that standard, economies of production are possible which enable the dealer to buy a uniform quality product which he can sell at a fair price to his customers.

Dealers thus profit from standarized cement because through it they secure a uniform product the quality of which is recognized by the United States Government. They obtain a product that is suitable for use and that gives satisfaction in any type of construction. They can buy it, under some brand, almost anywhere. They save money in conducting their business because it eliminates need of stocking and handling many different varieties. And through the economies of production and distribution which standardization makes possible they can purchase cement and sell it to their customers at a reasonable price.

On account of the beneficial results to everyone in the building industry following the standardization of cement, the practice of standardization is rapidly being adopted by manufacturers of other products both in the construction field and outside.

Sugar and Caustic in Concrete

The influence of sugar and potash shaft liquor on the setting and hardening of cement and cement mortar is as follows: A sugar content of from 0.1 to 0.25% in the setting water does no appreciable harm. Higher concentrations influence both the setting and hardening. Potash shaft liquor has little effect on Portland and are cement but under most conditions a great effect on aluminous cement. Anon (German Concrete Society, Circular No. 32, 1927).

Mineral Industries Conference Planned for Lehigh Valley

Several committees are now at work toward assuring the success of the Lehigh Valley Mineral Industries Conference to be held April 25th, 26th and 27th with headquarters at Easton, Pa. This event will afford a unique opportunity for Architects, Engineers, Draftsmen, Builders, Craftsmen, College Professors, Technicians, Associations, Industries and the citizens of a populous area to acquire a greater knowledge and appreciation of the Lehigh Valley district and of slate, cement and steel as important materials of construction.

Economic Changes in United States

The Committee on Recent Economic Changes met on February 21, at New York City, to perfect plans for the study of economic currents in the United States. According to Secretary Hoover, Chairman of the Committee, this study will constitute an inquiry to determine facts with regard to such questions as shifts in employment, changes in methods of production in industry and agriculture, and in distribution, shifts in relative price levels and profits, movements in the business cycle, shifts in standards of living, foreign trade and foreign credits, and other allied subjects which bear upon an understanding of the major business currents and the general business situation of the county. Private individuals have subscribed the necessary funds to enable the Committee to pay the expenses of the Bureau of Economic Research of New York, which will conduct the fact-finding survey with the cooperation of the Department of Commerce.

The personnel of the Committee on Recent Economic Changes includes the Chairman, Herbert Hoover; Secretary, Edward E. Hunt, Department of Commerce, and these members: Walter F. Brown, Assistant Secretary, Department of Commerce; William Green, President, American Federation of Labor; John Lawrence, President, New England Council; Max Mason, President, University of Chicago; Adolph C. Miller, Federal Reserve Board; Lewis E. Pierson, President, Chamber of Commerce of the United States; John J. Raskob, Vice President, General Motors Corporation; A. W. Shaw, President, A. W. Shaw Company; Louis J. Taber, Master, The National Grange; Daniel Willard, President, Baltimore and Ohio Railroad; George McFadden, George H. McFadden and Brother; Clarence M. Woolley, Chairman of the Board, American Radiator Company; and, Owen D. Young, Chairman of the Board, General Electric Company.

SPEED REDUCERS

Use and Application in Pit and Quarry Industries

By H. W. Munday

Part Three

SPEED reducers are coming to be recognized as an economic necessity in the pit and quarry industries. In this article of four parts we shall present a comprehensive outline of the subject as applied to these particular industries.

In part one the fundamental principles of speed reducers and the various types of units were dealt with.

In part two some particular units were discussed and the principle features of design presented.

In part three other particular units are described. Part four will complete the article and factors concerning the selection and installation of speed reducers will be discussed.—Editor.

Foote Bros. Gear and Machine Company manufacture spur gear reducers, herringbone reducers and worm gear reducers.

The Foote spur gear reduction units are manufactured in several different types according to the ratio of reduction desired. The housing for these units is cast iron. The pinion and gears are made of case hardened heat treated alloy steel. Phosphor bronze bushings are used throughout. Ball bearings are used in the high speed units. In all units the driving and driven shaft rotate in either direction. Each of the gears has its entire bearing either in the case or in one of the heads.

The various Foote spur gear unit types and the range of reduction ratios are about as follows:

Unit	Range
Type S	4 to 1 up to 7 to 1
Type CD	7 to 1 up to 10 to 1
Type D	10 to 1 up to 20 to 1
Type T	20 to 1 up to 80 to 1
Type QD	80 to 1 up to 100 to 1
Type QT	100 to 1 and upwards

By the combination of two spur gear reducers, larger reductions can be obtained.

Foote worm gear reducers are made in several different sizes. Each size is made with a single, double, triple and quadruple threaded worm. The different threads on the worm are used to increase the range of reduction. The reduction obtained by a single thread is four times that obtained by a quadruple thread.

In Foote worm gear reducers, the worm is cut from high grade steel and hardened and grounded if required. The worm wheel is offered either of semi-steel or English bronze with cast iron center. The housing is made of cast iron. The worm wheel bearings are of large size. Extra large ball thrust bearings are provided on each end of the worm.

Foote herringbone speed reducer units are of the continuous tooth type with thirty degree helix angle and 20 degree pressure angle. These units are made in three general types, single reduction units, double reduction units and triple reduction units. All these units are reversible and can be run in either direction. They are manufactured for ratios of reduction up to 250 to 1. Various reduction ratios are secured in the different types by changing the ratios of the gears and pinions of the gear trains.

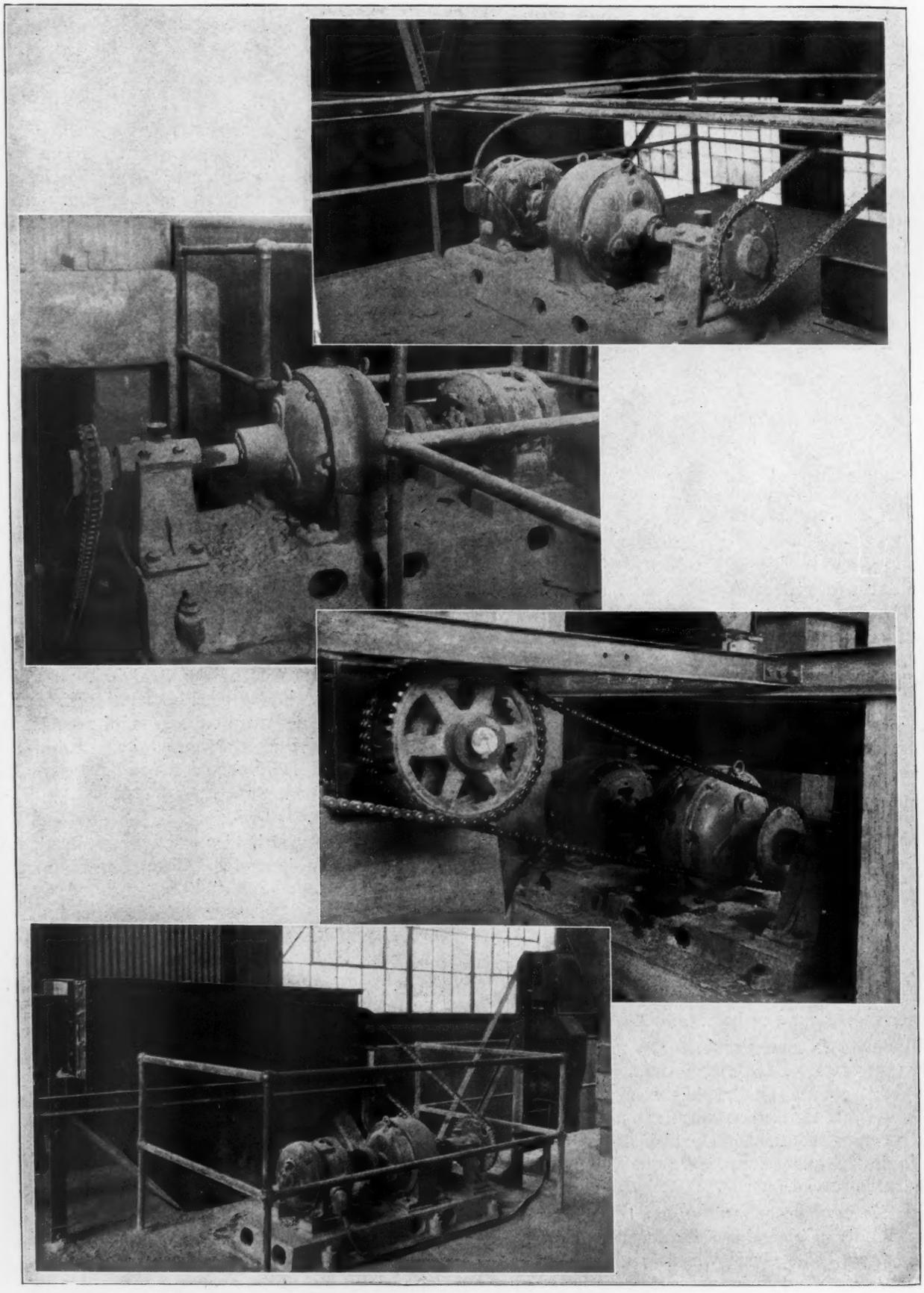
Foote speed reducer units are equipped with a splash system of lubrication. Baffle plates and bearing oil reservoirs are located above the bearings.

The De Laval Steam Turbine Company manufacture the De Laval worm gear reduction unit. This speed reducer unit is housed in a cast iron casing. The only moving parts in this unit are the worm, the worm wheel and the ball bearings of the worm shaft.

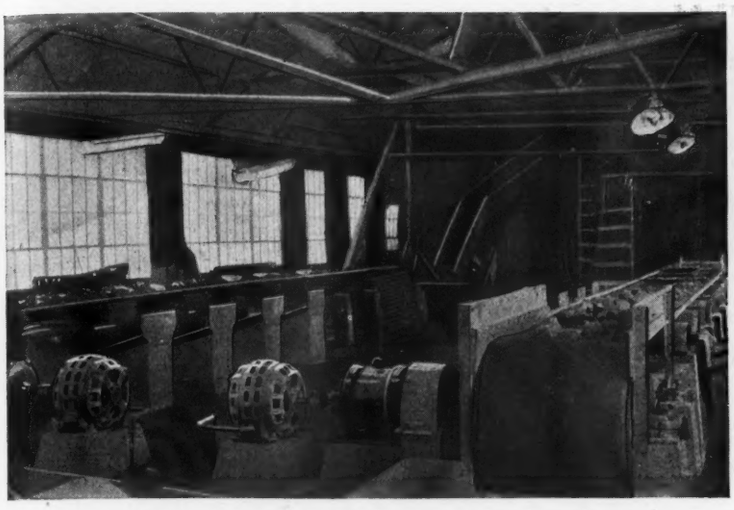
The De Laval worm wheel consists of a chilled cast phosphor bronze rim shrunk on a cast iron center. The worm is of the straight type and is cut upon a forged alloy steel shaft which is double heat treated. The worm runs in ball bearings, one of which is of the duplex combined radial and thrust type and the other of the radial type. The wheel bearings are made from metal having a low coefficient of friction.

Automatic lubrication is provided for all surfaces in sliding or rolling contact. Except in high speed heavy duty gears, the oil is distributed by the splash system. The lower member dips into the oil and carries it to the contact between threads and teeth. The oil thrown from the moving parts is caught in troughs cast in the cover that lead to the bearings. The bottom drive frames are also supplied with additional means for taking some of the oil off the wheel and transmitting it direct to the wheel bearings. A stuffing box with split gland is provided to prevent leakage of oil along the worm shaft.

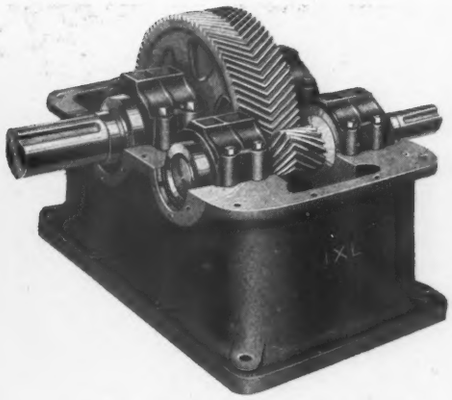
De Laval single reduction worm gear units are made for transmission ratios from four to one up to one hundred to one in one step. De Laval double reduction worm gear units are manufactured for ratios from one hundred to one up. For high speeds the De Laval unit is provided with a positive pressure oiling system. The worm threads and the teeth of the worm wheel are lubricated by a spray of oil and all the bearings receive oil under pressure.



Speed Reducers in the Plant of the Louisville Cement Company, Akron, N. Y. These Units Are Jones Speed Reducers.



Two Belt Conveyor Drives Through James Spur Gear Reducers Handling Gypsum Rock.



A Foote Single Herringbone Reducer.

The De Laval Steam Turbine Company manufacture a helical or twisted gear unit for relatively low ratios of speed reduction. In this unit an involute tooth is used. The gear and pinion are held in correct alignment by a rigid cast iron gear case and the driving and driven shafts are provided with De Laval flexible couplings. The splash system of lubrication is used.

The Hill Clutch Machine and Foundry Company manufacture the "Industrial Type" spur gear speed transformer. This unit consists of a simple train of spur gears. The housing is a one piece casting. It contains one large bearing. At one end is a removable housing bearing for the low speed shaft while at the other end is a removable housing bearing for the high speed shaft.

The gears are of the 20 degree involute form. Both high and low speed shaft are in identical axial alignment. Lubrication is automatic with the splash system in use by a disc on the high speed shaft. This disc dips in the oil reservoir and dis-

Falk Speed Reducer Driving Screw Conveyor in Plant of Dewey Portland Cement Company at Davenport, Iowa.

Huron Mill Type Reducer Driving a Screw Conveyor

Falk Herringbone Unit Driving a Weber Hydrator in Plant of Gibsonburg Lime Products Company

tributes the oil over all internal surfaces within the housing. Oil pockets and channels are conveniently arranged to make the lubrication effective.

The gears, shafts and oiling disc comprise all the moving parts of this "Industrial Type" unit. Complete units are made up in four, six eight and ten gear trains. The four and eight gear trains both have the same direction of rotation of the high and low speed shafts. The six and ten gear trains both have the opposite direction of rotation of the high and low speed shafts.

The Albaugh Dover Company manufacture spur and worm gear speed reducers and also a combined worm and spur gear reducer.

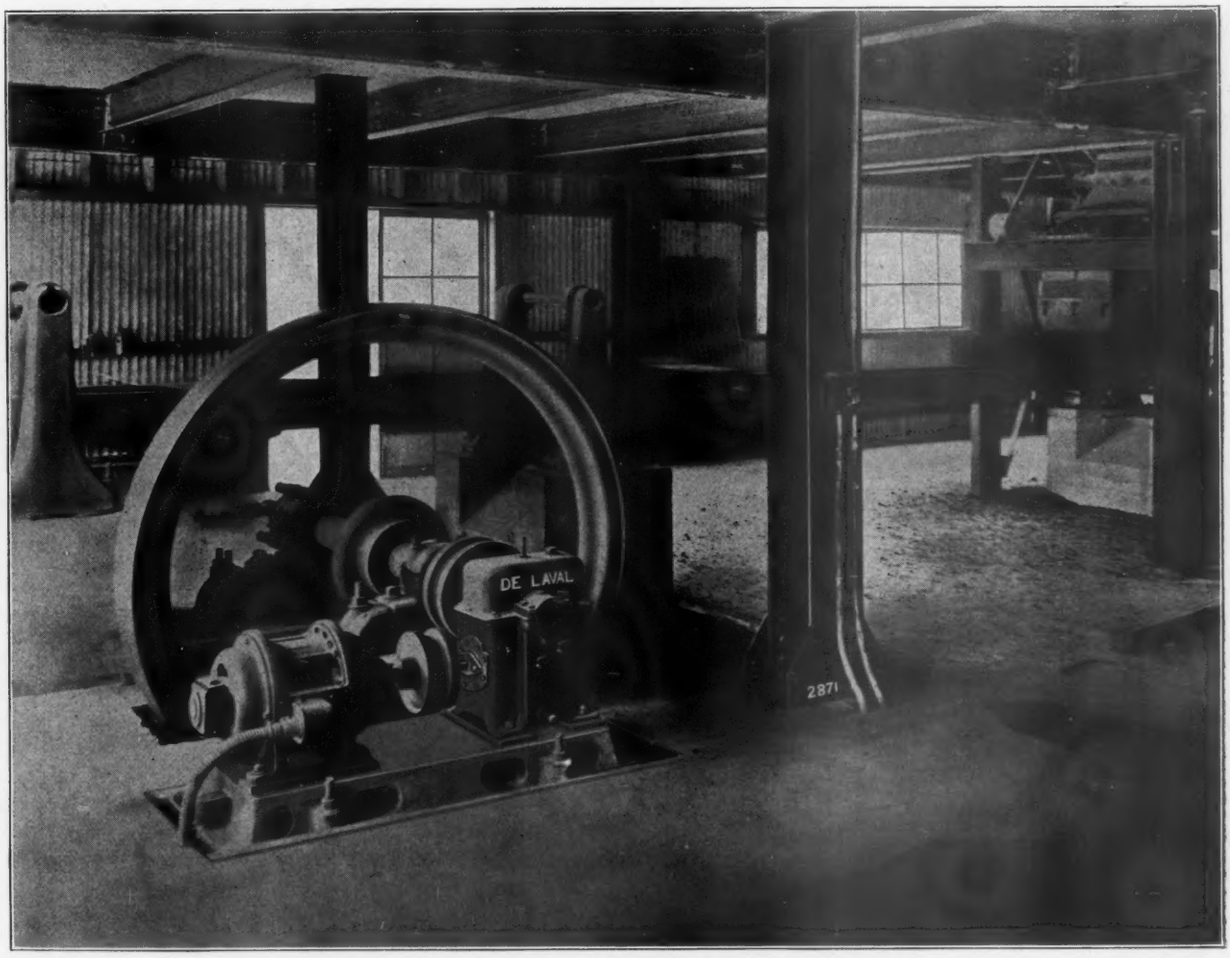
The straight line drive spur gear reducers are manufactured in ratios up to 20 to 1. The straight line tandem spur gear reducer is manufactured in ratios from 22 to 400 to 1. The worm gear reducers are made for ratios from about 4 to 1 and on up to 100 to 1. The combined worm and spur gear speed reducer unit is made in ratios up to 2,000 to 1.

The gears and shafts of the spur gear units are made of heat treated high carbon nickel alloy steel. The worms of the worm gear reducers are made of low carbon nickel alloy steel and pack hardened. The worm gears are made of bronze. The smaller gears are made entirely of bronze while in the larger gears the bronze is cast onto and interlaced with a cast iron center. The gears are mounted on ball and roller bearings of the standard type.

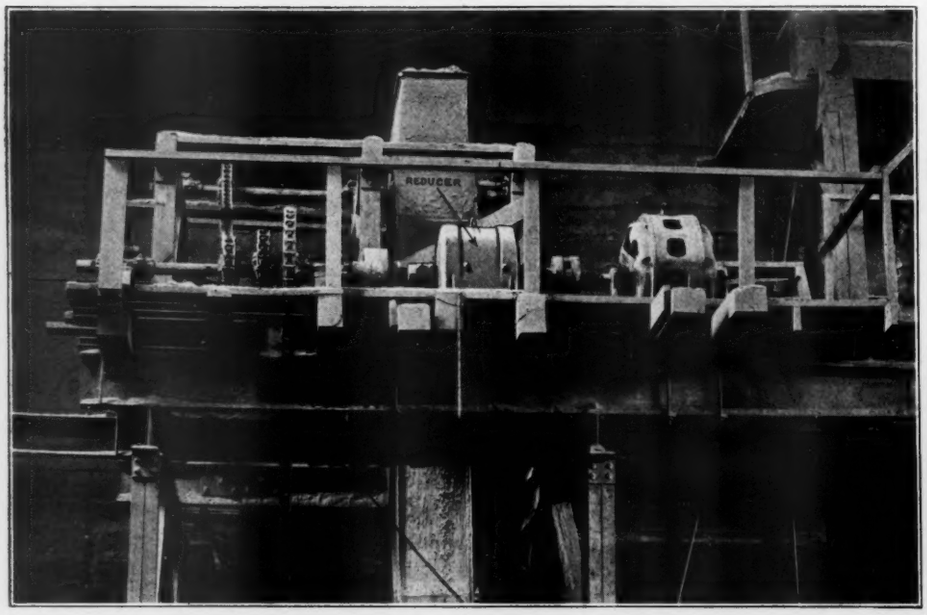
The splash system of lubrication is standard with Albaugh Dover units except in cases where the unit runs extremely low when forced lubrication is provided.

Horsburgh and Scott manufacture a helical spur gear and a worm gear speed reducer. The helical spur gear unit is made in units with two, three or four pairs of glass in the assembly. Helical gears are used for the initial high speed reduction. Heavy duty steel spur gears follow the first reduction. The high speed pinion shaft is mounted on anti-friction bearings. The high speed pinion is forged integral with its shaft. The spur gears are mounted on oversize shafts carried on oversize bronze journal bearings. An automatic splash type of lubrication is used.

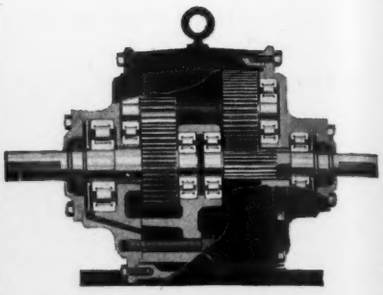
The Horsburgh and Scott worm gear reducers of the single type are made in three types for reductions up to 100 to 1. For larger reductions the double type unit is available. The worm is the straight body type integral with its shaft. The worm and shaft are a solid forging of low carbon steel, carbonized, case hardened and ground all over including the thread surfaces. The worm



De Laval Worm Gear Unit Driving a Skipulter in Plant of Valley Forge Cement Company at Conshohocken, Pa.

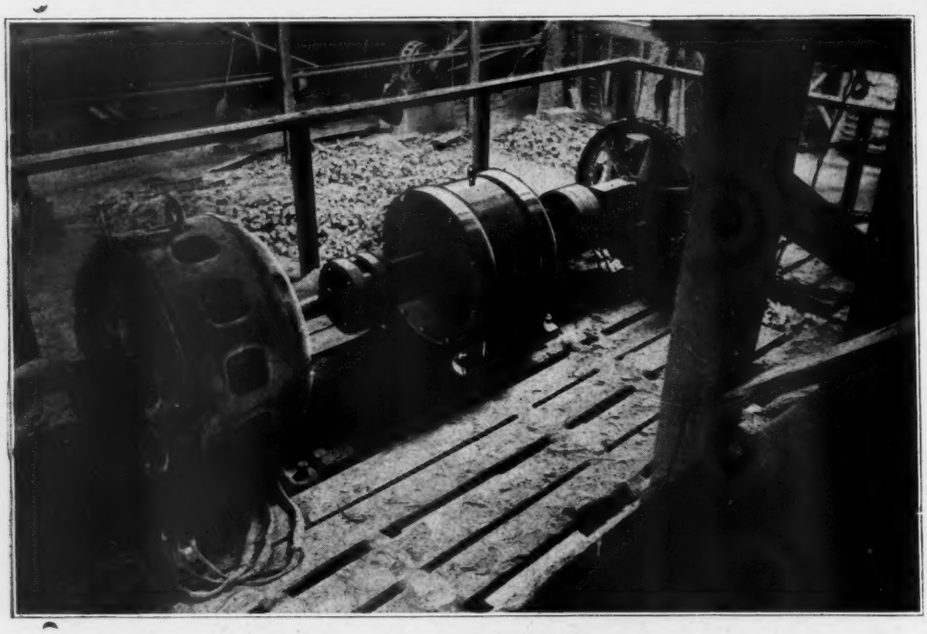


James Spur Gear Reducer Driving a Bucket Elevator Handling Cement



Albaugh Dover Spur Gear Reducer

Palmer Bee Unit Driving a Screw Conveyor



A James Spur Gear Reducer Driving a Screw Conveyor in a Cement Mill

shaft is mounted on ball bearings. The rear bearing is the duplex radial thrust type and the front bearing the straight radial type. The gear is made of gear bronze. In the smaller units, the entire gear is bronze. In the larger units, the bronze gear ring is shrunk on a cast iron center and secured by riveted steel pins.

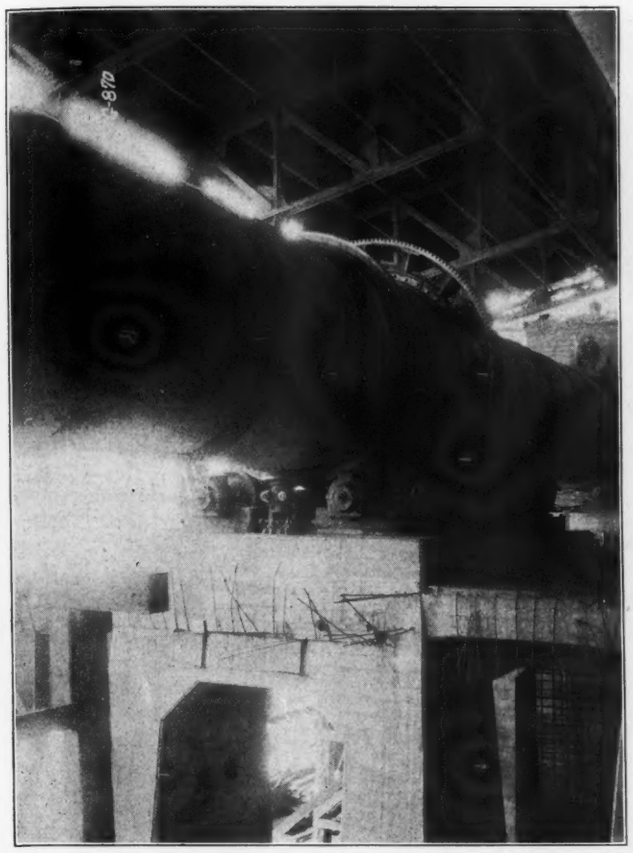
The Fawcus Machine Company manufactures worm gear speed reducers. In this unit the worm is forged integral with its shaft and case hardened after milling. The worm and gear are ground together. The gear shaft is made of 45 carbon forged steel. Either shaft or both are frequently made of chrome nickel forged steel for heavy bending loads.

All bearings are Timken tapered roller bearings. Special angle thrust type bearings are used on the worm shaft and the standard type on the gear shaft. The gear is made of hard bronze with a low coefficient of friction. The base and cover of the housing are of semi-steel braced between bearing hubs and foot.

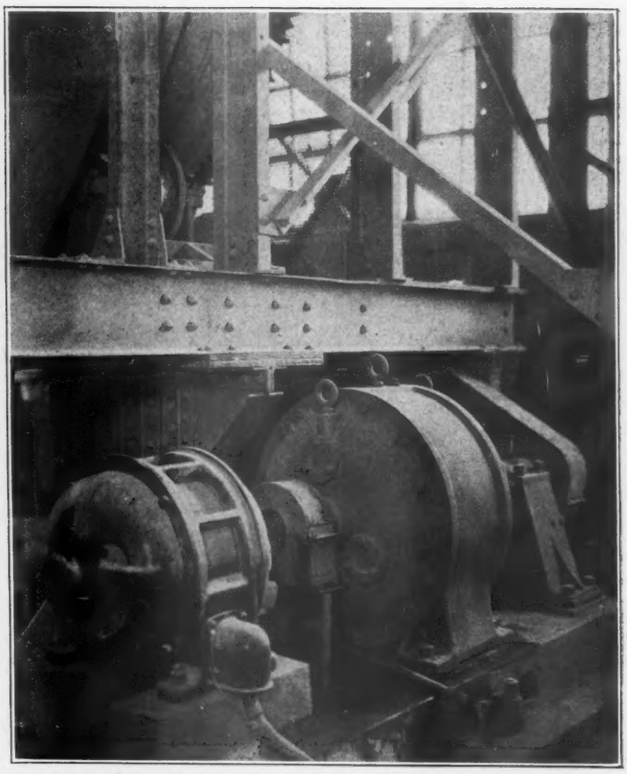
The R. D. Nuttall Companuy manufactures both single and double reduction vertical type non-planetary types. In the single reduction units the driving and driven shafts are parallel and offset in the same vertical plane. These units give maximum reduction ratios of 8 to 1 in the larger sizes and 7 to 1 and 5 to 1 in the smaller sizes. The double reduction units have the low and high speed shafts concentric. They give maximum reductions of about 46 to 1 in the larger units down to about 20 to 1. In the smallest units of this series a minimum reduction of 8 to 1 is possible.

These units are equipped with 7½ degree single helical gears. They are made from carbon steel and are heat treated and hardened. The pinions are forged integral with the pinion shafts and are also made of carbon steel heat treated and hardened. The shafts are hammered forgings heat treated and hardened. Timken tapered roller bearings are used throughout.

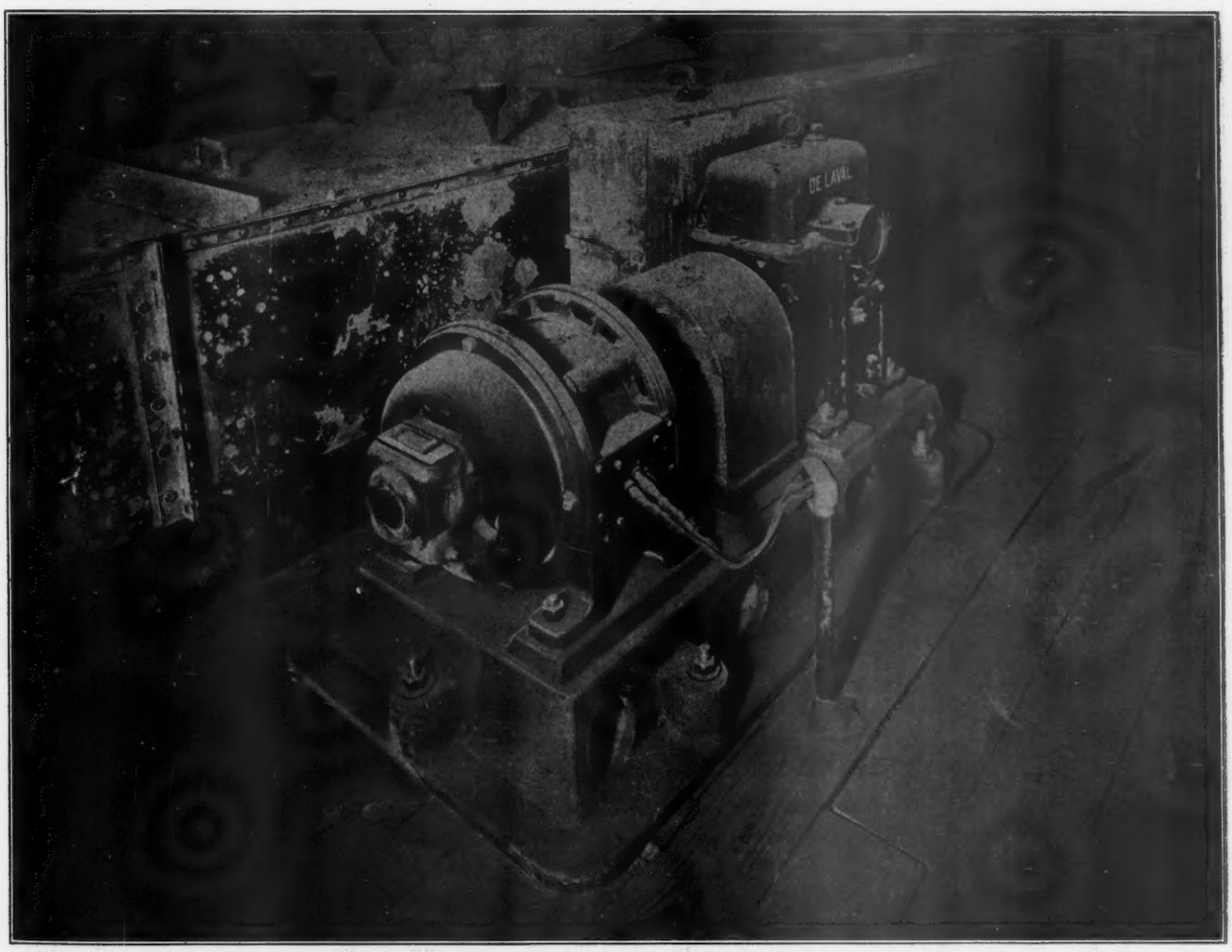
The housing is cast in three sections and is grey iron. A positive splash system of lubrication is used.



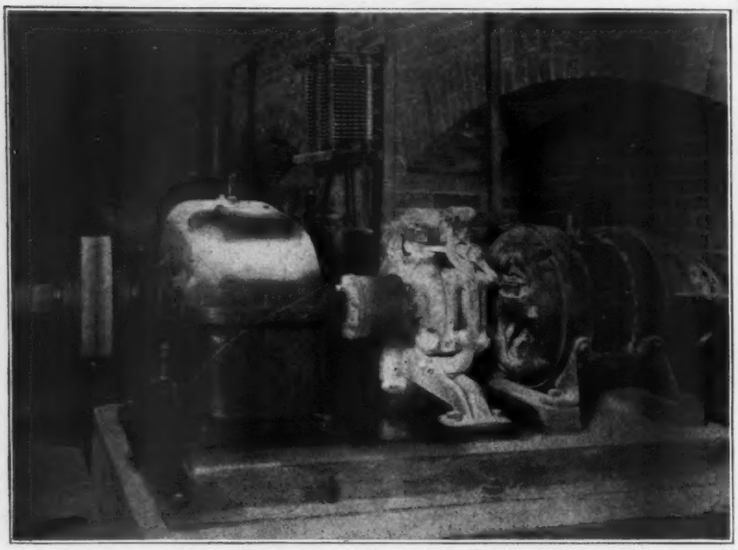
Falk Herringbone Reducer Driving a Kiln in Southwestern Portland Cement Plant at Osborn, Ohio. Large Gear Has 192 Teeth



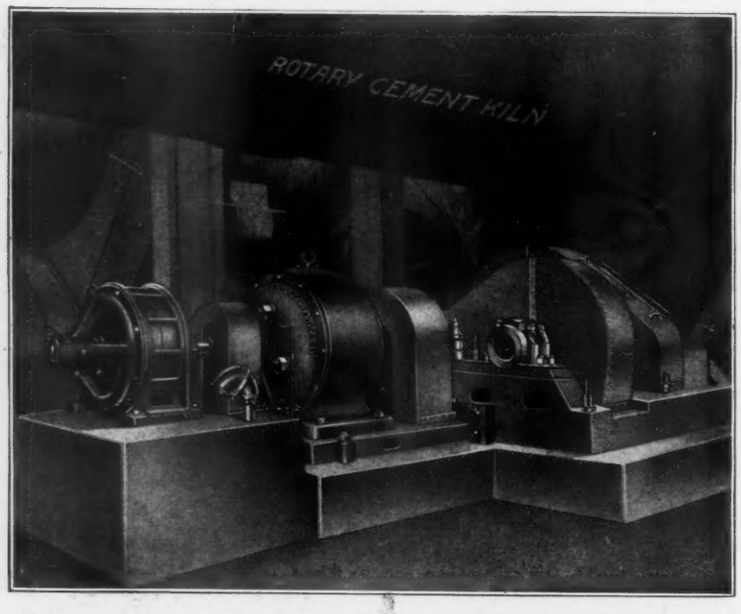
Jones Reducer Driving a Cement Bag Cleaner



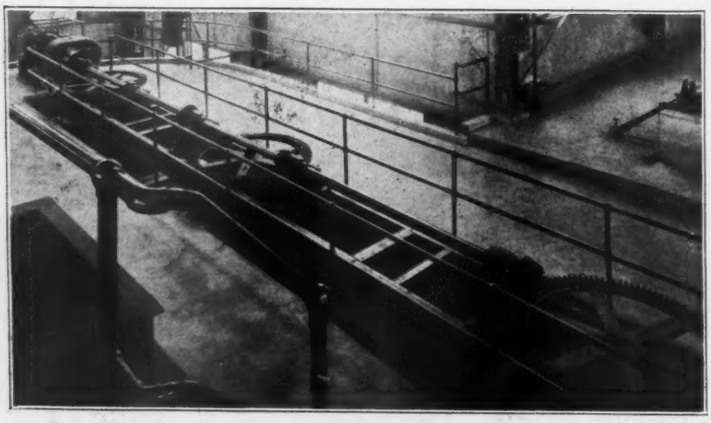
A De Laval Unit Driving a Screw Conveyor in Plant of Nazareth Portland Cement Company at Nazareth, Pa.



Foote Herringbone Unit Driving a Battery of Ball Mills



A Foote Spur Gear Unit Driving a Rotary Kiln



Palmer Bee Unit Driving Three Vertical Agitators

The William Ganschow Company manufactures a planetary type of speed reducer. The housing and side covers are made of semi-steel. The internal ring gears are made of high-grade carbon steel and the tooth shape is of the 20 degree stub type. The drive plate studs are made of nickel steel, heat treated, hardened and ground. The gears are of nickel steel. The bushings are made of bronze bearing metal. All bushings have spiral oil grooves.

The drive shaft and high speed pinions are made integral of nickel steel. The low speed shaft is made of forged nickel steel.

The Ganschow Company also manufactures a worm gear cpeed reducer. The worm is mounted in ball thrust bearings. The Ganschow compound type speed reducer was designed for slow heavy lriving.

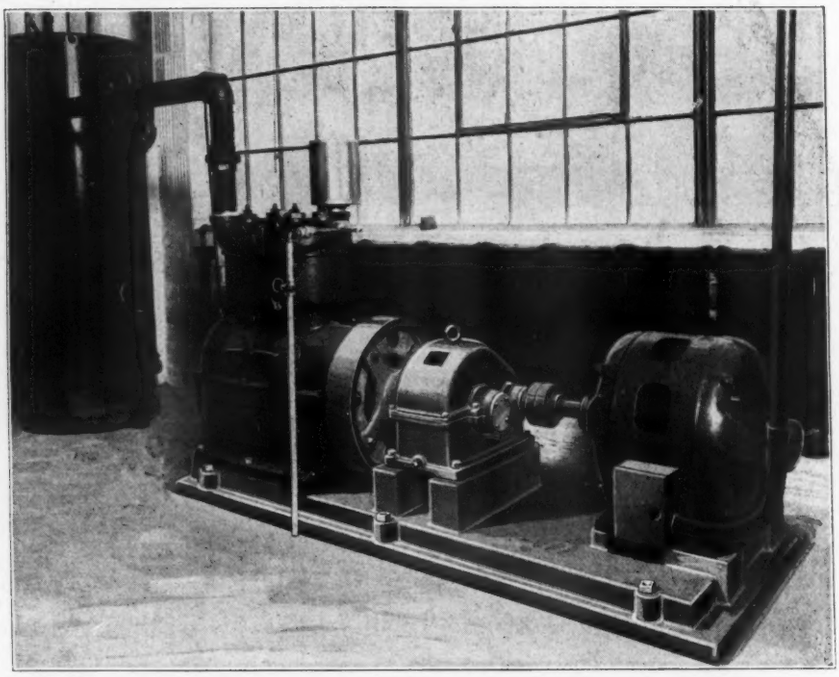
The Palmer Bee Company manufactures both mill type spur gear reducers and worm gear speed reducers. The mill type unit has wide face coarse patch straight spur gears from the lowest to the highest ratios. The housing is made in two parts. All shafts are through shafts supported in bearings at either end. All the gears and pinions rotate in tht same direction as the shafts. A combined oil bath and splash system of lubrication is employed. Reduction ratios from about 1½ to 1 up to 4,000 to 1 are possible.

Palmer Bee worm gear reducers are manufactured in several types. The housings are gray iron. The worms are of the straight type and are made of high grade steel, case hardened and ground. The worm wheel is machined to fit the worm and is made of either cast iron or bronze. The worm shaft can be run ineither direction. Timken roller bearings are used throughout.

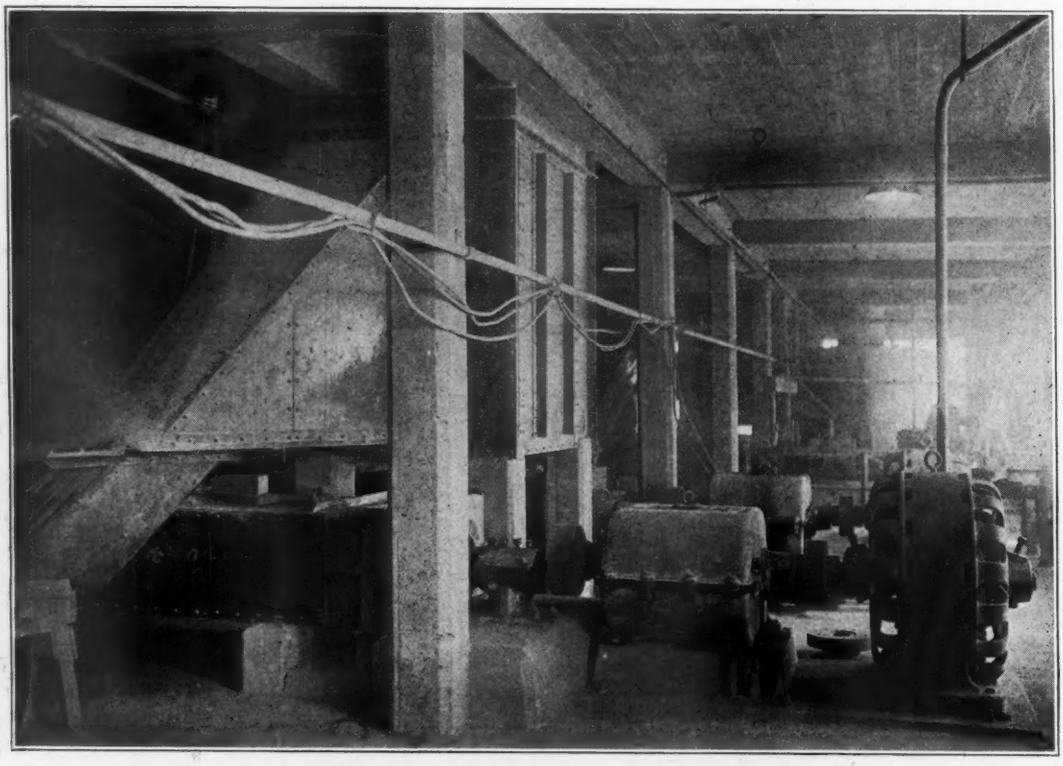
The Cleveland Worm and Gear Company manufactures single and double worm gear reduction units. The worms are of the straight body type with an involute thread havina a 30 degree pressure angle. These worms are solid forgings of low carbon nickel steel case hardened and ground. The gears in the smaller sizes are solid castings of chilled phosphor gear bronze. In the larger sizes the gear rims are cast on a cast iron center. Ball and roller bearings are used. In single units, consisting of one worm and one gear, ratios from 4 to 1 up to 100 to 1 are effected. The double reduction units give ratios as high as 5,000 to 1.

Several manufacturers, including The Fauk Corporation, W. A. Jones Foundry and Machine, D. O. James Manufacturing

Top View Shows a Jones Unit Driving a Drag Chain Conveyor Over Clinker Storage. Bottom View Shows a De Laval Unit Driving an Elevator in Plant of Nazareth Portland Cement Company at Nazareth, Pa.



James Herringbone Reducer Driving An Air Compressor In a Quarry House



Huron Mill Type Speed Reducer Driving Conveyor

Company, Huron Industries and the other speed reducer manufacturers besides those mentioned in this article have prepared elaborate charts, tables, etc., by which speed reducers can be selected for a certain service. From a study of this material and an investigation of conditions in the field we shall offer suggestions to be followed in selecting, installing and operating speed reducers in the pit and quarry industries. This will be done in part four and the last of this article.

The United States now has 666,900 miles of improved highway, according to the American Road Builders' Association. There is a great demand for additional improved highways in the secondary system.

Consolidation

By A. S. Deringer

In the canvass made several months ago to determine the reasons and possible remedies for the chaotic condition confronting the Lime Industry, some producers ventured the assertions that consolidation of interests was the one specific that would relieve the present and all similar situations.

In a recent communication from a producer of a kindred product, who voiced the same opinion and claimed "The over production of both lime and gypsum can only be controlled by merging the interests of the manufacturers of the two products."

From these various statements it is an apparent fact that not only would the merging of the interests of the individual products prove beneficial to the industry, but the merging of the kindred products would tend to eliminate the competition that naturally results in the distribution of the individual products. But the scope of such a consolidation would have to be more far reaching than simply to combine the distribution of the products. It would have to include the manufacture as well in order to be a harmonious organization. Some, no doubt, will advance the argument that each product has heretofore been able to maintain its individual standing in the industrial realm, against the products with which a consolidation is now suggested. All this we grant to be an indisputable fact. But conditions and situations arise that demand a change from the old order, which seems to be inevitable and unavoidable. Perchance some one of the industries was slightly more progressive than the other, which wrought a condition the other was forced to meet for its protection.

Nor were these conditions brought about by abrupt or overnight changes. They were a long time in reaching a climax. It is yet problematical if the climax has actually been reached. We would assume though, from the expressions voiced by some of the productions, that if the climax has not yet been reached, it is not far distant.

Some producers, and I venture to include those of both lime and gypsum, can see no need of the present agitation. Their claim is that the industry of which they are a part is as strong and substantial today as it ever was. This, too, we grant without an argument. But do these producers constitute the great majority? Some may be so located and so situated as not to experience any of the present reaction. Others may be so firmly entrenched in their stronghold that competitors have been unable to dislodge them. Again, others there may be who have a certain outlet for their product in certain segregated districts that have never been invaded by a competitor.

These, however, do not comprise the great bulk of the industry who must go out into the open market which is everyman's battle ground and fight hard and continually for any and all business. It is from among the ranks of the great majority that the suggestion of consolidation comes.

It is possible that these who suggest and would welcome consolidations are in the minority. Still the cry is abroad, and ere long some few will venture to take the initiative and form the nucleus around and about which will be formed a giant consolidation.

There are and always will be those who will scoff and condemn the idea of mergers and consolidations, and will use every effort to thwart the carrying out of such plans, which is always an indication that certain proposed projects have merit.

Huge consolidations have been formed in other industrial lines, and are functioning without any ill effects being experienced in the industry of which they are a part. They have to a great extent acted as a governor in their particular realm.

Whenever an industry suffers from the lack of confidence and cooperation that is brought about within the bounds of the industry, there is a great difficulty in restoring that spirit of cooperation unless it is forced upon the members of that industrial family. Nothing that we can conceive of will tend to draw them together and to cooperate for their mutual protection more surely than a strong staunch consolidation of some of their own industrial producers.

Unique Highway Fund Proposed

A bill (S-3559) authorizing the creation of a special highway fund from the proceeds of the sale of $407,341,145 worth of surplus highway equipment and war materials sold to France following the war has been introduced in the Senate by Senator James E. Watson of Indiana. The measure, providing this huge sum of money for highway construction, stipulates the funds are to be apportioned among the 48 states in the same proportion as the Federal-aid program. It is a companion bill to H. R. 10142, introduced in the House on January 30 by Representative Edward E. Browne, and which has already been endorsed by the Governors and Statt Highway Departments of twenty states.

The measure is unique in that it will add nothing to the tax payers burden, as the funds are to be secured solely through the payment of French bonds which will mature August 1, 1929 and which were given in payment of more than $2,000,000·000 worth of equipment and supplies.

"Its passage will mean the speeding up of five times of the present highway construction program in the United States," President J. Borton Weeks, told the Houst Committee on Roads during the hearings on the Browne bill. "The measure will have the undivided support of the 23,480,00 automobile owners in the country and should speedily be enacted into law as it is economically sound."

PIT AND QUARRY FOREIGN DIGEST

Acid Proof Cements

A plastic composition containing soluble silicates is formed by adding an alloy of silicon with magnesium, calcium, aluminium or iron to water glass cements. The alloy is pulverized and used in place of or in addition to the other fillers. I. G. Farbenindustrie. A. G. (British Patent 281, 689.)

Artificial Stone

A hot solution of magnesium, ferric or similar chloride is added to a mixture of magnesia and an earthly filler such as carbonate, siliceous or aluminous clay, calcareous earth, kaolin, sand, calcium sulphate, etc. When the filler consists of calcareous earth or alkaline clay, a metallic sulphate such as alum may be mixed with either the liquid or solid ingredients. In this case a dry product which sets upon the admixture of water may be obtained by adding the hot chloride solution to the filler and the sulphate, allowing the mixture to set, grinding it and then adding the magnesia. When the other fillers are employed a small quantity of an alkaline silicate may be added to the chloride solution. The product is useful as an artificial stone or plaster. W. A. Oakley (British Patent 281, 757).

Artificial Pumice

Finely powdered pumice (lava) is mixed with an aqueous solution of sodium silicate and the mixture kneaded in the moist condition and then moulded under dry pressure. It is dried in the air or in a kiln and then burned. Michelin et Cie (German Patent 453, 201).

The Binder and Aggregate of Concrete

From the calculation of the combined water in hardened cement from the soluble silicic acid and from that the calculated amount of dry Portland cement under the assumption that hardened cement contains 20% combined water, exhibits, especially with meager mixes, smaller values than those indicated by the loss on ignition. It is more nearly correct to calculate the mixing ratio from the loss on ignition of the mortar or concrete by means of the formula:

$$MR = 1 : \frac{100 - (4.545\ SiO_2 + \text{Loss on Ignition})}{4.545\ SiO_2}$$

The use of concentrated hydrochloric acid to dissolve the mortar or concrete, in the case of clayey aggregate gives incorrect results for the mixing ratio, in consequence of the considerable decomposition of the clay caused by the acid. But if dilute HC1 is used from 1 : 3 to 1 : 9 dilutions, the slight effect on the clay has no noticeable effect on the calculation of the mixing ratio. The error caused by the clay content of the sand may, therefore, remain unconsidered. V. Rodt (Zement, January 26, 1928).

Acid Proof Concretes

Acid proof concretes which involve the use of sodium silicate or silica gel and other patented products contain soluble calcium and magnesium salts and are not proof against the action of SO_2. By combinations of water glass, feldspar, chamotte sand, trass and minium, the Moscow Silicate Institute has succeeded in producing four varieties of concrete possessing great resistance to acid. But the production of acid proof concrete from Portland cement by means of acid proof additions must be considered unaccomplished, so long as the concrete contains soluble calcium i. c. compounds, and a truly acid proof material can be made only from those substances which are, in themselves practically insoluble in acids. G. N. Grigoriew (Tonindustrie—Ztg. Feb. 1, 1928).

Trass in Mortars

Trass from Karadag (Crimea) used in a 1 : 1 ratio with Portland cement gave an especially good mortar. In 1924, more than 80 tons of Karadag trass was used by the "nowoross-Zement" trust in Russia to test its sentability for use on the large scale. The results were good and this organization began the large scale exploitation of this stone. Trass mixtures are especially resistant to sea water. Acid proof concretes, which resist not only dilute, but more concentrated acids, such as H_2SO_4 and HNO_3 at both high and low temperatures have been prepared. Trass, being zeolithic can also be used to reduce the hardness of water, experiments showing a reduction from 12 to 2 degrees of hardness. G. N. Grigoriew (Tonindustrie—Ztg. Jan. 28, 1928).

Thermal Analysis of Portland Cement

The changes in weight of Portland cement, its raw materials and its hydration products, on heating have been observed with a thermo-balance. The decomposition of limestone commences at 600 degrees, becomes vigorous at 690 and ends at 700. A sudden change in the weight of gypsum takes place at 104 degrees and the loss is completed at 660 degrees. The change in weight of hydrated Portland cement takes place in three stages. The first is at about 100 degrees due to expulsion of free water while the others are at about 400 and 600 degrees due to the decompositions of calcium hydroxide and calcium carbonate respectively. S Uchida (Rept. Sendai High. Tech. Sch. Research 5, & Kondo C. A.).

INTIMATE NEWS OF MEN AND PLANTS

Sulphur and Pyrites in 1927

The production of sulphur in this country in 1927 amounted to 2,111,618 long tons, compared with 1,890,027 tons in 1926, an increase of 12 per cent, and was the largest production ever recorded, according to the United States Bureau of Mines, Department of Commerce. The shipments in 1927 were practically the same as the record-breaking shipments of 1926, being 2,072,109 tons, valued at approximately $38,300,000, compared with 2,072,657 tons, valued at approximately $37,300,000, in 1926. Stocks on hand at the mines were increased approximately 40,000 tons in 1927 and totaled 2,100,000 tons at the end of the year. This is the first year since the closing down of the Sulphur mine, Louisiana, in 1924 that the production of sulphur has been equal to or larger than the shipments. Over 99.9 per cent of the production was made by two companies in Texas, while over 99.9 per cent of the shipments was made by these companies and the company in Louisiana which is still shipping from stocks. Production and shipments of sulphur were also made by two other mines, one in Nevada and one in Utah.

The average quoted price for sulphur was higher in 1927 than in 1926. As reported by trade journals the prices quoted throughout the year were $18-19 a ton f.o.b mines. Open prices were $1 a ton higher than the above and prices for sulphur exported were given as $22-$24 a ton f.a.s. Atlantic ports.

Exports of sulphur or brimstone from the United States totaled 789,371 long tons in 1927, valued at $16,269,254, of which 175,602 tons were exported to Germany, 165,141 tons to Canada, 126,664 tons to France, 114,597 tons to Australia, 50,775 tons to Netherlands, 36,450 tons to the United Kingdom and 25,978 tons to New Zealand. Exports of sulphur or brimstone in 1926 amounted to 576,966 tons. The exports in 1927 were the highest ever recorded and exceeded by nearly 160,000 tons the previous record exports in 1925. Exports of refined, sublimed, and flowers of sulphur increased 150 per cent, from 12,002,105 pounds, valued at $236,146 in 1926, to 30,266,810 pounds, valued at $529,346, in 1927 and were mainly to Canada, Germany, United Kingdom, and Australia. Imports of "sulphur and sulphur ore" for 1927 amounted to 3,384 long tons.

The output of pyrites increased from 166,599 long tons, valued at $616,668, in 1926, to 215,786 tons, valued at $804,006, in 1927, or nearly 30 per cent in quantity, and was the largest output recorded since 1920. The quantity sold or used by producing companies also showed a large increase, from 163,217 tons in 1926 to 206,724 tons in 1927, or 27 per cent. California and Virginia produced the entire tonnage recorded for 1927.

Imports of pyrites in 1927 showed a decrease of 32 per cent in quantity and 24 per cent in value, from 366,151 long tons, in 1926 valued at $856,981, to 250,794 tons, valued at $647,512. Of the total quantity imported in 1927 Spain furnished 241,591 tons and Canada the remainder.

The increase in domestic production was not large enough to offset the drop in imports of pyrites in 1927, so that there was a decrease of about 66,000 tons in the quantity of pyrites made available for consumption.

Large Shipment of Equipment for Pacific Coast Cement

Shipment of equipment for the $2,500,000 plant of the Pacific Coast Cement Company at Seattle is said to be en route over the lines of the Williams Steamship Company. It is announced that the Traylor Engineering and Manufacturing Company is furnishing over 2,000,000 pounds of the equipment among which are two kilns each 40 feet long by 11 feet 3 inches wide; two coolers 90 by 9 feet; and rock crushers, according to G. W. Walters, the Seattle representative of the Traylor Company. The motors, switchboard and most of the electric equipment is being furnished by the General Electric Company.

Workability of Concrete Discussed by Celite

The Celite Products Company is distributing its bulletin entitled "Designing Concrete for Workability as Well as Strength." It is illustrated by photographs and diagrams together with tables and abstracts from papers treating on the subject, and calls particular attention to its engineering service bulletin 6-325 which covers all phases of the use of Celite in concrete. The words "Consistency" and "Workability" are defined and their relationship is shown as regarding concrete mixes. According to the bulletin, the workability of concrete when three pounds of celite is added for each bag of cement is increased 76 per cent over plain concrete, based on a similar flow.

Illinois Association Elects

The annual meeting of the Illinois Sand and Gravel Association was held at Springfield, Ill., February 28th. The following officers were elected for 1928: President, O. J. Ellinger of Mendota; vice president, John E. Sankey of Springfield, and secretary-treasurer, R. E. Weaver of Lincoln, Ill. These same officers served during 1927.

Monolith Enlarging Plant

The Monolith Cement Company of Bakersfield, California, is planning an expansion campaign to ultimately cost $350,000 in rebuilding its plant in Tehachapi Valley, 50 miles east of Bakersfield. The Monolith now has a payroll of 300 employees and has orders sufficient to justify the proposed increased capacity.

Herzog Expands

Herzog & Son, operators of a quarry and lime kiln in Patterson, near Kenton, Ohio, have started a $120,000 expansion campaign, it was announced. A 42-inch gyratory, a 24-inch secondary and a reducing crusher are among the numerous improvements and additions which will require approximately 120 days to complete.

Beaver Portland Renews for Spring Demand

Prior to the advent of spring with its increased construction the Beaver Portland Cement Company of Gold Hill, Ore., has started operations at its plant. Cars have begun to transfer the raw materials from Marble Mountain to the plant, following a three months' suspension, and, according to C. W. Martin, superintendent, a continuous prosperous period is in prospect.

Monolith Builds Addition to Cement Plant

The Monolith Cement Company of Tehachapi, Calif., is planning a $250,000 extension program. At present 300 men are employed at the plant, but the present orders justify the expansion program as announced.

Alabama Plant Completed

The plant of the Alabama Lime and Stone Corporation of Birminghom, Alabama, has completed its lime plant at Calera and the new kilns are in operation. The crushed stone plant recently completed is producing 4,000 to 5,000 tons daily.

Ottawa Silica Purchases Property of U. S.

The Ottawa Silica Company has purchased all the property of the United States Silica Company, including a modern mill, drying plant and 65 acres of sand land. It is announced that the plant will be continued in operation without any change in the personnel and W. J. Witt will be retained as manager.

Bausman Gravel Plant Nears Completion

The Bausman Washed Sand and Gravel Company of Troy, Ohio, has signed a number of contracts for its new plant which is nearing completion. It is announced by Mr. Bausman that the washing plant will be completed by April 15. The entire Gabriel farm of 65 acres is under lease and the steam shovel is in operation getting the material ready for the completion of the plant.

Schoentag Purchases Quarry

Sale of the stone quarry owned by John B. Dymond at Waymart, Pennsylvania, to the Schoentag Corporation of Philadelphia has been announced. The stone to be taken from the quarry will be used in the construction of that portion of the Roosevelt highway running through Wayne County, Pennsylvania.

Gilmore Cement Plant to Open

The Gilmore City, Iowa, cement plant, closed since its purchase by the Northwestern States Cement Company of Mason City two years ago, will be opened about April 1, according to announcement. The plant will first ship crushed rock and later make cement, because of the extensive highway program of the State of Iowa. Officers of the company are, C. H. McNider of Mason City, president; A. F. McFadden, vice-president; Hanford McNider, treasurer, and F. G. Ray, secretary.

Indiana Engineers Meet

More than 100 engineers and representatives of the State Highway Commission attended the dinner of the Indianapolis Section of the Indiana Engineers' Society at the Spink-Arms Hotel, Indianapolis, March 5. The Indiana Sand and Gravel Producers Association and the Indiana Crushed Stone Producers were represented. R. E. Crum, engineer of materials and tests of the Iowa Highway Commission and R. T. Giles, former test engineer of the North Carolina Commission, were the principal speakers.

New Incorporations

Bonded Granite Co., Bellevue, Ky. $10,000. Irvin C. Meyer, Louis C. Shure, L. R. Shure.

California Talc Co., care of Corp. Trust Co. of America, Wilmington, Del. $150,000.

A. Y. Reed Gravel Co., Builders Bldg., Chicago, Ill. Charles A. Jacobs, V-P. and Gen. Mgr.

Walkill Sand & Gravel Co., East Orange, N. J. 2,500 shares common.

William A. Rogers & Co., Sparta, Mich. $75,000. Agnes F. Ballard, Belding; William A. Rogers, Lusina H. Rogers, Sparta.

Anaoco Gravel Corp., Inc., De-Ridder, La. $15,000. C. A. Russell, Jr., Orange; E. W. Ogden, 4309 Montrose Bldg., Houston, Tex.

Durham Sand & Gravel Co., Inc., Durham, N. C. $25,000. C. E. Kimbrough, John W. Keem, E. J. Schabelit.

Baily Gravel Co., Inc., Indianapolis, Ind. $8,000. Francis P. Bailey, E. Sommerlao, August L. Bailey.

Alfred-Atlas Gravel & Sand Corp., Alfred, N. Y. $16,000 pfd.; 200 shares com. J. T. Foody, Hornell.

Kokomo Stone Co., Toledo, O. 400 shares n.p.v. Richard D. Logan, W. G. Scheub, W. D. Bolin.

Tallassee Land Co., 512½ Market St., Knoxville, Tenn. F. L. Ambrister, Sr., F. L. Ambrister, Jr., Asa Ambrister, Asa Hazen, Lee A. Gridley.

Marus Marble & Tile Co., Memphis, Tenn. $30,000. Gene Marus, Paolo Marus, A. L. Alexander, A. J. Yates, John Marus.

Dorsey & Nelson Marble Co., Columbia, Tenn. $10,000. S. G. Dorsey, John L. Nelson, L. Z. Turpin, Elizabeth Woody, Mrs. John L. Nelson.

Reed Corporation Reorganized

Organization of the A. Y. Reed Gravel Corporation of Elgin, Illinois, for the absorption of business of the A. Y. Reed Gravel Company has been announced. The offices of the company will be moved to the Builder's Building in Chicago. Charles A. Jacobs becomes vice-president and general manager, and Herman Grotmeyer is retained as superintendent.

Building Asphalt Plant

R. E. Hayard of San Diego, California, is building an asphalt paving plant at El Centro. The R. E. Hayard Contracting Company operates a fleet of 50 motor trucks and claims to be able to deliver asphalt paving material to any town in the valley at 350 degrees Fahrenheit, or over.

Burr Hughes Purchases Stone Quarry

The Burr Hughes Company, realtors of Rockwood, Illinois, is launching a campaign for better homes of stone construction. It has purchased the Martin Stone Quarry, south of Rockford, and is planning to install equipment to furnish rock for the macadam streets in the Guilford Heights development. Burr Hughes is now building the first of a series of stone homes on High Crest Road which will be veneered with quarried stone, have quarried slate roof and plate glass windows. In the interior of the home will be incorporated all the latest building refinements and comforts.

Kiln Fired at Chieftain

Fire was started in the first kiln of the Black Marble and Lime Company at Chieftain, Oregon, February 18th. The plant is in charge of Floyd W. Allen, construction engineer, and John Yokum, superintendent, who announce another kiln will soon be placed in operation.

Grotto Cement Plant Starts

Operations of the new cement plant of the Northwestern Cement Company at Grotto, Washington, started early in March. It is announced that the company has orders for 300,000 barrels of cement and employs between 200 and 300 men.

E. P. Martin in Chicago

Edward P. Martin is in charge of the Western office of the Protectomotor Air Filter at 1823 Prairie Avenue, Chicago, Ill. A complete line of filters is carried at this office for immediate delivery.

Allis-Chalmers Appoints

Allis-Chalmers Manufacturing Company announces the appointment of Mr. R. T. Stafford, formerly district manager of the Seattle office, as assistant manager of the electrical department in charge of sales and engineering at Pittsburgh Transformer Works.

Mr. John Alberts of Seattle office has been appointed district manager, succeeding Mr. Stafford. The Seattle district embraces the states of Washington and Oregon, having a branch office located at Portland.

New Ross Bulletin

Ross Power Equipment Company is distributing its latest listings of new and used equipment. It has on hand all classes of machinery for use in the pit and quarry industries.

NEWS OF EQUIPMENT MANUFACTURERS

Allis Chalmers Acquires Tractor Plant

The Allis Chalmers Company has acquired the stock of the Monarch Tractors Corporation at a cost estimated in excess of $500,000, according to a recent announcement by Gen. Otto B. Falk, of the Allis Chalmers Company. The Monarch plant is located on South Tenth street at Stafford avenue, Springfield, Ill., including assembly and machine shops of modern construction with approximately 75,000 square feet of floor space on one floor, also offices, engineering and storage departments. The property comprises six acres of land, served by a private switch of the Chicago & Alton and the Illinois Traction Belt Line, assuring convenient transportation facilities. There will be no change in the name of the Monarch Corporation and no change in the management personnel is anticipated, R. W. Gottshall continuing as president and H. B. Baker as sales manager.

Shovel Sets High Elevation and Cold Weather Record

Reports have been recently received of the very unusual performance of a gas shovel operated by S. M. and S. J. Feeley, Denver contractors. The machine, a 1¼ yard heavy duty gas shovel, has been operating at an elevation of 12,500 feet, with the mercury at 45 degrees below zero. The machine is working about 150 miles from Denver, and is about 30 miles from the main line of the railroad, with the snow ranging from 5 to 7 feet deep.

The contractors are digging a ditch 14 feet wide on the bottom with 1½ to 1 slope, and 7 miles long. The material handled is of granite rock, slightly shot and cast over the lower side of the mountain. The machine has been double shifted the past 90 days and is averaging 770 yards per eight-hour shift in rock. It is believed that this is the highest elevation and the lowest temperature at which a gasoline shovel has been operated successfully to date. The machine is an Osgood 1¼ yard heavy duty gasoline type, equipped with Le Roi 4-cylinder motor.

Awards to G. E. Employes

Inventions in lamp-making equipment which resulted in a saving of $190,000 in labor cost and a machine investment saving in excess of $400,000 and a saving of floor space previously used by the now obsolete machine, brought Charles A. Coffin Foundation Awards in 1927 to John J. Malloy and Ludwig Staudenmeir, of the National Lamp Works. Announcement of the awards to Malloy, Staudenmeir and 24 other employes of the General Electric Company in factory, engineering and commercial departments was made recently by the advisory committee.

The Charles A. Coffin Foundation was established in 1922 when the board of directors appropriated the income of $400,000 "as an expression of appreciation of Mr. Coffin's great work not only for the company but also for the entire electrical industry, and with the desire to make this appreciation enduring and constructive, as Mr. Coffin's life and work have been."

Annual rewards are conferred for the most signal contributions by employes of the General Electric Company toward the increase of its efficiency or progress in the electrical art; to that public utility company in the United States which has made the most outstanding contributions to progress in its field during the year; to the electric railway company which has performed a similar service; and to a certain number of graduates of American colleges and technical schools whose work promises to be a valuable contribution to the electrical art who need assistance for that purpose.

Rollway Issue Bulletins

The Rollway Bearing Company has issued recently a new catalog 4-A on their wide series and utility type of bearings and also a number of bulletins as follows:

Bulletin No. 54—Various Precision types of Rollway Radia Bearings.

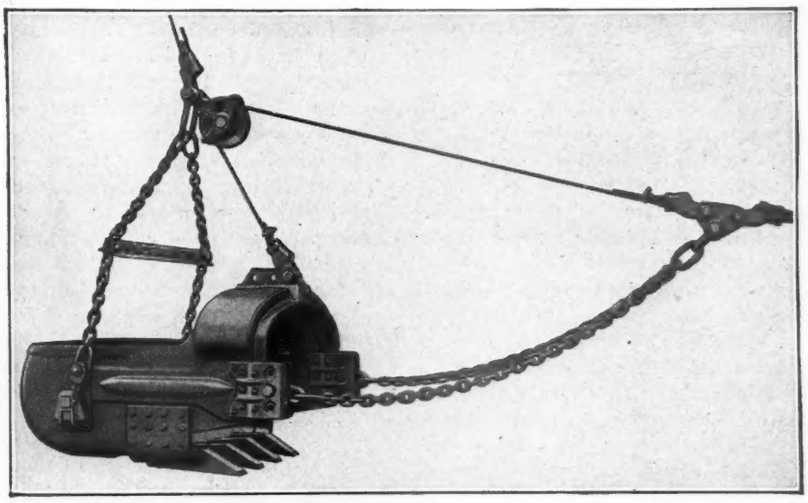
Bulletin No. 55—Self-Aligning Pillow Blocks equipped with Standard Rollway Bearings.

Bulletin No. 56—Large Rollway Bearings in the recently adopted International sizes.

New Type of Dragline Bucket

Harnischfeger Corporation, large builders of gasoline driven excavators, is now manufacturing dragline buckets in sizes ranging from ½ to 1¼ cubic yards, on which a bulletin has been issued. These buckets are designed to withstand severe dragline service. The bottom and sides are shaped from a single piece of heavy tank steel and all seams are electrically welded. Welded construction provides a smooth inside surface, and prevents sticky soil or weeds from clinging to the bucket. The teeth are heavy steel forgings, securely bolted through the cutting lip and bottom of the bucket. It is a difficult problem to prevent the sides of a dragline bucket from drawing together at the front end. However, this type, with large box section hood and heavy "Z" bar supports promises to eliminate much of the trouble.

The drag chain clevis is provided with lugs which pull against shoulders in the hitch plate thereby transmitting the pulling stresses direct from the bucket to the chain instead of through the connecting pin. The pin merely acts as a guide and is not subject to bending strains.



New Type Draglfne Bucket

New Hoist Catalog

What is considered a complete and helpful catalog on the subject of electric hoists has just been issued and is now ready for distribution by The Chisholm Moore Manufacturing Company. It is called bulletin Number 31 and is one of a series of material handling equipment bulletins being prepared and published by the same company. The electric hoist bulletin has a cover in two colors and the reader is immediately introduced to the contents by an illustration of one of the hoists in use.

The inside pages show that care and thought were given to their arrangement and sequence. The result is a catalog that covers its subject with completeness and clarity.

Starting with a short treatise on the importance of electric hoists in industry, it covers the various types of hoists, illustrates their use, describes their operation and care and gives diagrams and tables of clearances, dimensions and other data.

New Induction Starter

A new automatic induction starter with two adjustable features has just been announced by the Lincoln Electric Company. One of the adjustments is in the starting current and starting torque and is made by changing the position of the rotor in the regulator. This rotor is index mounted and the starting torque and starting current of the motor are increased by going to the higher numbers and decreased by going to the lower. The other adjustment is in the current at which the throw-over takes place which is controlled by a retarding solenoid which is operated by the motor current. The pull of this solenoid can be adjusted by a simple lock rod arrangement carried on its plunger.

The contacts in this switch are designed to give that wiping action which is a feature of the modern switch. Overload protection is afforded by thermo-relays and the no-voltage protection by no-voltage release control. The switches are now operating successfully on blowers, compressors, textile machines, machinery tools, welders, presses and wood-working machinery.

H. C. Beckwith Returns

Mr. H. C. Beckwith has returned to The Byers Machine Company, Ravenna, Ohio, as president and general manager. Mr. L. S. Shaffer is vice president and treasurer, C. H. Collier, manager of sales.

Mr. Beckwith's return to active management of the affairs of the company is in line with the expansion program which has been undertaken. As is generally known in the trade, Mr. Beckwith was general manager of the Byers Machine Company for a number of years through its development period, but retired in 1926 and resided for some time in the West.

Byers has recently purchased The Massillon Power Shovel Company, at Massillon, Ohio, and has announced a very complete line of shovels and cranes, including new Byers Bear Cat models, both half and full revolving, and Byers-Massillon Shovels. The latter include gas, electric, and steam powered shovels of 1 and 1¼ cubic yard capacity.

Power Plant Equipment Subject of Catalog

The Elliott Company is distributin its 36 page illustrated bulletin Q-1 entitled "Power House Equipment." The associates of the company for more than 25 years have been the Liberty Manufacturing Company and the Lagonda Company, and it has acquired the Kerr Turbine and more recently the plant and products of the former Ridgway Dynamo and Engine Company. The bulletin contains turbines for generators and mechanical drives, reduction gears, steam engines, generators, synchronous motors, converters, generator sets, centrifugal blowers, compressors, condensers, air ejectors, deaerators, deaerating heaters, feed water heaters and all necessary equipment for a complete power plant installation.

Haiss Portable Conveyors Discussed in Catalog

The George Haiss Monufacturing Company is distributing Catalog 1127, "Portable Conveyors." The 24 pages are illustrated with photographs of actual operations of the conveyors, drawings which show clearly the mechanical construction and tables of data giving the operating information on each class of gas or electric, flat belt or troughing type and includes references to many users of these conveyors. Reference is also made to creeping model loaders in catalog 527, clam shell buckets in catalog 425, screens, chutes and hopper gates in catalog 623, and a number of publications on other conveyors and elevators, as required by the industries.

Modern Power Transmission

The Morse Chain Company has recently issued its 156 page catalog, "Morse Silent Chain Drives" with the rocker joint, which is being distributed. The bound volume is carefully indexed and a very convenient asset to the mechanical engineer, as the tables and data on power transmission are comprehensively arranged. The principal illustrated discussions are the drives in service, according to industry and drive unit; action and construction of the chain; comparison with old methods; how to design drives; classes of sprockets; installation of drives; and special and automobile chains.

G. E. Secretary Retires

Myron F. Westover, secretary of the General Electric Company for the past 34 years, retired on March 1 and William W. Trench, assistant secretary, has been elected by the board of directors to succeed him. Mr. Westover has been actively identified with the electrical industry for 40 years, his first position being secretary to the late Charles A. Coffin, then treasurer and manager of the Thomson-Houston Electric Company. Mr. Trench is a native of Staten Island, a graduate of St. Lawrence University, the Brooklyn Law School and was admitted to the bar in 1916.

New Equipment Company

Houck Bohan Equipment Company, not Inc., has recently been formed by F. E. Houck and Lloyd J. Bohan, formerly Chicago District sales representative of Geo. D. Whitcomb Co., and also of Bohan & Co., Machinery Sales Agents. They will represent the Midwest Locomotive Works, Star Drilling Mach. Co., O. K. Clutch & Machy. Co., and N. P. Nelson Iron Works in the Chicago territory. Offices are at 178 West Adams Street.

Atlantic Association Meets

The South Atlantic Crushed Stone Association, of which E. Ragland of Raleigh, N. C., is president, held a convention in Raleigh, February 20, 1928.

Magnetic Appoints

The Magnetic Manufacturing Company has appointed Mr. T. F. Scannell as exclusive representative for the St. Louis territory on the complete line of magnetic separation equipment, magnetic clutches for power transmission, etc. Mr. Scannell's office will be located at 502 Ambassador Building, St. Louis. Mr. Scannell was formerly connected with the Chain Belt Company of Milwaukee.

W. M. Smith Returns

William M. Smith who was for many years associated with the wire rope department of Wickwire Spencer Steel Company and resigned to take up similar duties with another manufacturer of wire rope has returned to the Wickwire Spencer organization. He will handle the sale of wire rope in the Pittsburgh district.